THURSDAY, MARCH 18, 1915.

SCIENCE AND INDUSTRY.

WHATEVER the political changes resulting from the present European struggle may be, it is certain that the industrial and economic changes will be of an equally striking and revolutionary character. Those of us who can remember Europe as it was before the war of 1870 and now look back upon the forty-five years which have elapsed since that fateful conflict, cannot fail to realise that the transfer of Alsace and Lorraine from France to Germany was an event of vanishing importance compared with the gigantic disturbance which has been brought about in Europe and throughout the world by the unprecedented industrial expansion of Germany which has taken place during the same period. Some idea of the stupendous magnitude of this rapid development in the matter of chemical industries may be gathered from the figures cited by Prof. Percy Frankland in a lecture recently delivered before the Society of Chemical Industry, and of which an abstract was published in our last issue. The magnitude and variety of the German chemical industries are surpassed in wonder only by the rapidity with which they have developed from the very small dimensions which they possessed prior to the war of 1870. Still more remarkable, however, is the fact that a similar investigation of many other activities, such as the textile, mining, metallurgical, electrical, agricultural, and shipping industries, would reveal developments almost equally startling.

It is this great industrial prosperity which has rendered possible the vast and amazing effort to secure German supremacy in Europe of which we are the spectators to-day. The older ruling class in Germany had but little interest in commerce and industry as such but it had the sagacity to see that its dreams of empire could only be realised by fostering industrial and commercial enterprise in every possible way. The ruling class, at bottom despising the tradesman in every shape and form, has had the wisdom to recognise that its prejudices must be concealed, and that everything must be done to put the wealth-producing classes into the most favourable position for competing with the similar classes of rival countries. The rulers of Germany had the discernment to apprehend that one of the most important weapons in that competition was education, and that education must not be of a uniform, stereotyped, and antiquated pattern, but must be elastic and carefully adapted to the needs of each particular class of the community. Education of every kind has been promoted, not only by pecuniary endowment but by the granting of exceptional privileges, both material and social, to those possessing attainments of a higher order, *e.g.*, by the reduction of military service to a period of one year only in the case of all boys who have passed beyond a certain school standard. Research of every description, not only in science but in every other branch of learning, has been fostered to an extent quite unknown in any other country.

This has resulted in Germany becoming beyond all other countries the land of the expert, "a country of damned professors," as Lord Palmerston once called it in the language of a bygone day. It is the country in which every man is proud of knowing his own particular business, nor will he be listened to on any other subject. In England, if a man succeeds in catching the public ear, his utterances on every conceivable subject will be accepted by thousands. Nothing is more astounding than the faith which large sections of people put in the omniscience of our prominent men. We can well remember how Mr. Gladstone, who had adopted the plan of replying by post-card to his innumerable inquirers, was once not only asked for his opinion on the efficacy of vaccination, but actually thought fit to express it. Other and much more recent examples of the faith reposed in self-constituted oracles amongst us will occur to most of the readers of NATURE. In Germany knowledge is so widely diffused, and it is so generally understood that real knowledge can only be attained by years devoted to some kind of research, using the word in its widest sense, that most educated Germans are aware that any given individual, however brilliant, can only be an authority in a comparatively limited field of knowledge. In Germany, therefore, it is only the opinion of the accepted expert that counts. If Germany is the land of experts, England is undoubtedly the land of amateurs, and, owing to the extraordinary genius of our countrymen, it is quite true that in the past most striking achievements must be credited to amateurs. Priestley and Cavendish were amateurs, as were Darwin and many others of high distinction that could be mentioned, but they assuredly became experts also in fact, if not in name.

Science is the dynamic and creative force in

industry, and it is only through scientific discovery that industry can rapidly advance. It is this fact which has been freely recognised in Germany, whereas it is from this fact that the great majority of Englishmen instinctively shrink. The German believes in shaping his practice on theory, whilst the Englishman moulds his practice on tradition and instinct, and avoids all theoretical considerations as far as he can. In the earlier stages of chemical industry, and whilst chemical science was in a rudimentary state, much was accomplished by the eminently practical instincts of Englishmen, but with the increasing complexity and refinement of the problems involved, progress has only become possible through profound knowledge gained by unceasing investigation directed by theoretical considerations, and it has been during this later phase that such rapid strides have been made by the chemical manufacturers of Germany.

Of all the chemical industries, the one which depends most entirely on a far-reaching knowledge of chemical theory is that of Synthetic Organic Products (Artificial Dyes, Drugs, Perfumes, etc.), for it would certainly require instincts of even a super-British order to be capable of devising methods for the economic manufacture of such commodities as indigo, adrenalin, and ionone! It is not surprising, therefore, that this branch of chemical industry is almost entirely in German hands, whilst the other branches are, for the most part, gravitating in the same direction.

It is not the unexpected which has happened, for that the neglect of science by our manufacturers would inevitably lead to this result has been consistently preached by British chemists during the past forty years. The irony of the situation lies in the fact that this relative failure of our chemical industries to expand has gone on *pari passu* with a great increase in our output of chemical research, the quality of some of which has been of a particularly brilliant kind. That this capacity for research has remained almost wholly divorced from industry is due to the British manufacturer, who has almost entirely failed to attract into his works the more brilliant chemists trained in this country. The remuneration and prospects offered are in general of such a disadvantageous character that they cannot be entertained excepting as a last resort. It is, moreover, the absence of any prospect of reasonable remuneration in industrial chemistry that greatly limits the study of chemistry as a profession in this country. The Government and the municipal corporations, in their capacity as employers of chemists, are no better than the manufacturers.

That the British manufacturer is himself in general entirely ignorant of chemistry is the result of our antiquated system of education. Whatever school he may have attended will almost certainly have been presided over by a headmaster reared in traditions of medievalism, with the result that he probably imbibed the idea that the study of science would relegate him to an inferior position in the school; at the university, unless he were reading either classics or mathematics, he would not, even at the present day, be in the swim, and would find little or no favour with the head of his college, whilst until recently he would have been of no account at all. He would then pass into his hereditary position in the factory knowing nothing of the science upon which the business is based, and incapable of understanding even the alphabet of the language of the chemical officers it may possess. What wonder, then, that he distrusts and fears these chemists, who are the brain of his business, and that he prefers to confide in the engineers, who are but little less ignorant of chemistry than himself.

That this is the typical situation in the chemical industries of this country was revealed in a particularly significant manner in the House of Commons only a few nights ago, when the Government scheme of "British Dyes, Limited," was under discussion. At the conclusion of the debate, the Parliamentary Secretary of the Board of Trade said that the man who was conversant with the science and practice of dye manufacture was unfit to go on the directorate, because, as he would know something of the business, the whole of the other directors, being but business men, would be in his hands. We are thus authoritatively informed, from his seat in Parliament, by the Secretary of the very Board which is entrusted with the duty to look after the commercial and industrial interests of the country, that the first qualification of a director of a public company subsidised by the Government is that he must know nothing of the business in which that company proposes to engage. Surely the report of this speech must have escaped the astigmatic eye of the official censor, or he would have passed his pencil over a piece of information so gratifying and useful to the enemy! As Prof. Armstrong, in commenting on this utterance in a letter to the *Morning Post* on Saturday last, very truly remarks: "Our fate as makers of dyes is sealed. We, the taxpayers, can do nothing but

look on while our million and a half is squandered by directors who now confessedly are to be men without business knowledge of the industry they control."

If we would take advantage of the great opportunity which this war affords for industrial and economic rearrangements, it is imperative that the ruling classes in this country should no longer continue in their present state of semi-education which passes as culture, and which permits them to go through life with little or no understanding of the vital importance of science to the State. If after the war we are to recover some of the chemical industries which we have lost, and even maintain those which we still possess, it is essential that the individual undertakings should be controlled by men who have a real and expert knowledge of the business in which they are engaged, and that our legislators should have had sufficient scientific education to enable them to understand such problems connected with these industries as may be brought before them. The experience of the past thirty years points unmistakably to the conclusion that industrial success is becoming more and more dependent upon the co-ordination of industrial effort, and the embarrassing position in which we find ourselves at the present moment, in respect of the supply of a number of chemical products, is largely attributable to the almost entire absence of any such organisation. In both France and Germany we understand that councils of experts have been appointed to inquire into the effects of the war on the chemical industries of these countries, and to report to their respective Governments as to what legislative measures are desirable for promoting their welfare. As the present crisis is on a scale which we trust may never recur in the history of the world, so the opportunity for discarding mischievous traditions, effete ideas, and clumsy methods of procedure is of such an altogether exceptional character that it is to be hoped we shall not allow it to pass unutilised through ignorance, lethargy, or divided counsels.

THE CHEMISTRY OF FOOD PRODUCTS.

Food Products. By Prof. H. C. Sherman. Pp. ix + 594. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1914.) Price 10*s.* net.

APART from the analytical side, chemistry in its application to food products is a neglected science in this country in comparison with the activity which exists in America. The neglect, however, has been, in the main, in official and public circles, as several of the British food manufacturers of repute have availed themselves of scientific help for some years past, and it may be claimed that the high—not to say world-wide—repute of the products of some of these firms is to some extent due to the resource of, as well as the control exercised by, their scientific staff. In the United States, legislation has been very largely the cause of the awakening of the public interest in its food, and in this connection the name of Dr. H. W. Wiley will be remembered with gratitude by present and future generations. Whatever the cause, the development of the investigation of the composition and value of food products has been exceptionally rapid during the past few years: it is manifested by such outward signs as the foundation of university chairs in food chemistry in America, and the publication of informative text-books.

As the moment is ripe for reform, the wisdom of founding such a chair at our own Imperial College of Technology may be urged: there is much to be done, for example, in educating the public as to the food value of many low-priced products from our Colonial Empire, which are at present neglected, and in showing manfacturers how to make better use of the available raw material.

Dr. H. C. Sherman, who occupies the chair of food chemistry at Columbia University, has produced an exceptionally informative book, in which he combines an account of the production and preparation of the various food products for the market, with statistical data, details as to their chemistry and physiology, and an outline of the latest scientific research and opinions.

The book also contains a large number of up-to-date tables giving the food values, protein content, and mineral constituents of all sorts of foods, and is, indeed, replete with information of every kind, so that it will be indispensable to every food chemist and manufacturer. All the principal food products are dealt with in turn, each chapter being concluded with a list of references to the literature. Though much of the information given is outside the ordinary scope of the college trained chemist, it corresponds exactly with the practical details which the actual worker requires, and we do not remember to have seen this given so succinctly anywhere else. The more advanced scientific sections are equally satisfactory, so that current views are expressed without undue dogmatism: this is especially the case in the more physiological sections.

A good deal of space is devoted both in an appendix and elsewhere to the rules and regulations for the enforcement of the Foods and Drugs

Act in America. These are of great interest to the British reader in view of the possibility of more drastic food legislation here, though fortunately the sale of inferior food materials is not tolerated to anything like the extent that existed in America. It is commonly understood that the most drastic legislation was necessary there to combat the existing evils, although its severity has to some extent acted in restriction of trade. In any case, such movement here should be official and under the guidance of responsible scientific opinion, and not sponsored by irresponsible "Pure Food Institutions."

The university courses of study are already so crowded that there is no time for the introduction of food chemistry into the degree course, nor, indeed, is such desirable. The would-be chemist, if he is to play his part in building up British industries, must be trained as a chemist first and as a specialist afterwards. Books such as this will be of the utmost service at the stage when the young chemist has to act on his own and to take responsibility. Prof. Sherman has done a great service to his colleagues. From the point of view here developed it is to be hoped that he will compress rather than enlarge future editions, so that the book may be read and not consulted as a dictionary. E. F. A.

APPLIED BOTANY.

(1) *A Text-book of Grasses, with Especial Reference to the Economic Species of the United States.* By Prof. A. S. Hitchcock. Pp. xvii+276. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1914.) Price 6*s.* 6*d.* net.

(2) *A Manual of Weeds.* By A. E. Georgia. Pp. xi+593. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1914.) Price 8*s.* 6*d.* net.

(1) ALTHOUGH we are disposed to welcome any innovation in the planning of text-books of applied science, we cannot congratulate the author of the work under review on the scheme which he has adopted. He divides his book into two parts, and treats first of economic agrostology, and subsequently, of systematic agrostology. As a consequence, the student who begins the book at the beginning reads of a considerable number of grasses, mostly called by their popular names, and if he be a novice, he must pause at each page to look up, in the systematic part, what these names signify. Moreover, whether he be novice or adept, he will find but little information of real value in the economic section. He will discover how much corn and wheat and barley and other cereals is grown in the United States, and how much each of these crops is worth; that America eats wheaten bread, and that the inhabitants of the "Old World" subsist on wheat, corn, and rice. Beside some useful general information, he will find a chapter on lawns, and a page or two on sand-binding grasses.

It may be that this somewhat discursive treatment is all that is possible in the present stage of "economic agrostology"; but whether it be so or no, we feel convinced that the proper place for it is at the end and not at the beginning of the volume.

Part ii. opens with an account of the morphology of the vegetative and floral organs of grasses. The descriptions are terse and clear, but their value is reduced very materially by the fact that not one figure is given by way of illustration, neither of the vegetative organs nor of the somewhat difficult inflorescence and flower. This is the more remarkable in that the succeeding taxonomic chapters are well and copiously illustrated.

The experience of the reviewer convinces him that it is impossible to teach the systematic botany of grasses unless the student has first mastered thoroughly the floral morphology of typical forms, and doubt may be expressed whether such mastering may be obtained by merely following the written text.

The taxonomical section, which occupies nearly half the book, follows in part the classification adopted by Bentham and Hooker, and, with respect to the "tribes," that of Hackel. The code governing nomenclature is not that laid down in the Vienna rules, but is "The American Code of Botanical Nomenclature." To criticise this decision scarcely becomes a non-American reviewer, but he may express a regret that systematists cannot come to a general agreement which will prevent these games of nine-pins with names. For example, all the gardens of Europe know Pampas grass by the name *Gynerium argenteum*. In this book it is called *Cortaderia argentea*, and no indication is given whether *Gynerium argenteum* is synonymous with *C. argentea*, or whether the latter is another plant under the same common name. Buffon said long ago that it was easier to learn botany than botanical nomenclature. The systematists seem to take a joy in maintaining the truth of the aphorism.

(2) M. Boutroux has insisted recently that sentiment no less than will and intellect must be reckoned with in the psychological make-up of mankind. No one who has fought with weeds, whether in the farm, the garden, or the golf-green will doubt it. The fight was stubborn and its fortunes varied, but whether won or lost, the

weeder left the field with a deep respect for his adversaries: so stubborn is the resistance that they offer, so various are the means by which they evade extermination.

Here they all are, hundreds of them catalogued and described in this book, and although the weeds treated of are those which trouble the American cultivator, the English farmer and gardener will recognise many of his old foes. He will also learn not a little of new ways of fighting them. For America takes its weeds seriously—more seriously even than the good farmer of this country. He tracks them to their lairs in the hedgerows and keeps a sharp look-out on them in his neighbours' plots. He even invokes legislation upon them. He needs be vigilant indeed, for field labour is not cheap or plentiful in his country, and the chief means of combating weeds—constant cultivation—cannot always be practised. We confess to a certain feeling of unmalicious pleasure, like that we have in the misfortunes of our friends, when we saw the weediness of the fields of certain parts of North America. Nevertheless, the American will win in his fight with weeds; for he threatens them with all the resources of organic chemistry. Not only are the sulphates of iron and of copper pressed into his service as weed-killers; but, and more recently, weeds are being attacked with fine sprays of kerosene or crude petroleum.

The author of this manual writes with sureness on her subject. She knows weeds well, describes them admirably, and gives much sound advice on the methods to be adopted for their eradication. In fact, this is the best book yet published on weeds and one that will prove of considerable service to cultivators in this country. High praise must be given also to F. Schuyler Mathews for the excellence of the 385 illustrations. Their value is enhanced by the fact that they face the page of text on which they are severally described.

One suggestion only would we offer in the interest of the busy reader of the book: that a new edition should include an appendix in which the means of control, and weeds controlled by these means, are classified.

LANTERN- AND MICRO-PROJECTION.

Optic Projection Principles, Installation and Use of the Magic Lantern, Projection Microscope, Reflecting Lantern, Moving Picture Machine. By Prof. S. H. Gage and Dr. H. P. Gage. Pp. ix+731. (Ithaca, N.Y.: Comstock Publishing Co., 1914.) Price 3.00 dollars.

THE use of the lantern in one of its many forms has become more and more general. In our younger days it was a great and exceptional treat to see a magic lantern entertainment, but now there are kinematograph theatres in all our main streets, and lanterns for the teaching of history, geography, and science in our schools, so that the younger generation look upon the lantern as a matter of course, and even the poorest of them go (perhaps too frequently) to the picture palaces.

The number of operators using the lantern has thus enormously increased in the last few years, and the lantern is acquiring quite a literature of its own. The volume under review treats the subject very fully, and collects into one volume a large amount of valuable information on every aspect of the subject. It is intended to be available to the ordinary unscientific rule-of-thumb operator, as well as to the manufacturer, and to the unscientific demonstrator or student. To meet the needs of the first of these, plain, practical directions are given in the earlier part of the book for using the direct-current arc, the alternating arc, the miniature arc, the lime-light, etc.; also practical summaries of what to do and what to avoid are added to each chapter, and there are similar practical instructions for using sunlight with a heliostat, for projecting opaque objects, for micro-projection, the kinematograph, and many other applications of the lantern. Presumably with the idea of making each section complete in itself, there is a great deal of repetition in these chapters. This will probably be of advantage to the practical man who is interested only in one form of projection, but it makes this part of the book tedious to read.

In the later part of the book there are many valuable tables and curves giving, for instance, the relations between current, voltage, and candle-power of the different forms of arcs and their distribution of light intensity; also the light and the energy absorption of the various media—glass, water, etc.—that are used in projection apparatus; and the reflecting powers and light distribution of lantern screens.

In the last chapter are some applications to physics. We should like to have seen this further developed; brief as it is, it explains how to demonstrate some beautiful experiments in advanced optics—experiments which are not often shown.

The instructions for adjusting the radiant are somewhat misleading. It is said that it should be placed at the principal focus of the first section of the condenser (§ 55), and it is said that there is a loss of light if the lamp is brought nearer. In almost every case this is not so, a bigger cone of light being embraced; in practice the second lens of the condenser is not made

a weak lens, but the lamp is pushed up within the focus of the first lens, and it is very rarely that an operator changes his condenser when he changes his objective, as laid down in § 89.

The only other criticism is that in projecting the rings and brushes in convergent polarised light, the objective does not focus the back *lens* of the second convergent system on the screen, but its back *focal plane*; this mistake is, however, generally made in the optical text-books.

It should be added that there is a useful bibliography and a copious index.

MATHEMATICAL WORKS.

(1) *Elements of Geometry*. By S. Barnard and J. M. Child. Parts i.–vi. Pp. ix+465. (London: Macmillan and Co., Ltd., 1914.) Price 4*s*. 6*d*.

(2) *A Foundational Study in the Pedagogy of Arithmetic*. By Dr. H. B. Howell. xi+328. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1914.) Price 5*s*. 6*d*. net.

(3) *Constructive Text-book of Practical Mathematics*. By H. W. Marsh. Volume iii. Technical Geometry. Pp. xiv+244. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1914.) Price 5*s*. 6*d*. net.

(4) *Algebraic Invariants*. By Prof. L. E. Dickson. Pp. x+100. (New York: J. Wiley and Sons, Inc.; London, Chapman and Hall, Ltd., 1914.) Price 5*s*. 6*d*. net.

(5) *Plane Trigonometry and Tables*. By G. Wentworth and D. E. Smith. Pp. v+188. *Trigonometric and Logarithmic Tables*. By G. Wentworth and D. E. Smith. Pp. v+104. (London: Ginn and Co., 1914.) Price 5*s*.

(1) THIS is not a modified edition of the authors' well-known text-book entitled "A New Geometry for Schools." In form, grouping, method, and to some extent, subject-matter, it differs widely from their former work. The experience gained from eleven years' teaching on modern lines has led them to certain conclusions which they embody in the present volume. To some extent, they revert to older methods, as, for example, in the treatment of parallels, tangents, the early theorems of the second book of Euclid, and the grouping of cognate theorems. In other respects they adopt a more radical position by introducing trigonometrical ratios and sections on solid geometry (mainly numerical) at an early stage. They have compressed an immense amount of matter into a compact form, and the array of numerical and theoretical exercises is almost alarming in its extent.

(2) The science of pedagogy is arousing increasing interest in this country, although, curiously enough, less among those engaged in teaching at our public schools than at primary and other secondary schools. But the literature of the subject has received comparatively few British contributions. The object of the author is, in his own words, to summarise the anthropological, experimental, pedagogical, psychogenetic and phylogenetic resources now available, which bear on the part arithmetic should play in a scientific curriculum. His investigation is fourfold: (1) genetic, (2) psychological, (3) statistical, (4) didactical. Not the least interesting and valuable part of the book is the account of experiments, arranged and conducted by the author on the determination of ability in number apprehension and fundamental processes.

(3) It is strange to pick up a text-book on geometry and fail to find a single diagram before page 150. The explanation lies in the fact that the author believes that each student should, by his own researches, write his own text-book. That such a mode of procedure as is indicated by the plan and structure of this book has been in operation for nearly twenty years is conclusive evidence of the enthusiastic personality of the author: that many teachers, however, could adopt his method seems to us highly improbable. His purpose is to enable each pupil to build up for himself a logical geometrical structure, by the aid of appropriate suggestions made at the right time. The form these are to take and the quality of the work expected of the pupil is set out in great detail. We doubt, however, whether the author will make many converts.

(4) This monograph provides a simple and admirable introduction to the theory of invariants of algebraic forms. It is divided into three parts. The first deals with linear transformation from the point of view of (1) change of axes of reference, (2) projective geometry. Jacobians and Hessians are discussed, the latter in connection with the solution of the cubic and the points of inflexion of a cubic curve. The second treats of algebraic properties, such as weight, annihilators, reciprocity, differential operators, etc. And the concluding section introduces the symbolic notation of Aronhold and Clebsch. Some carefully selected sets of examples are provided.

(5) The form and plan of this text-book indicate that the changes in the teaching of elementary trigonometry have taken place along similar lines on each side of the Atlantic. The practical aspect of the subject is now regarded as requiring chief emphasis in the early stages and the abstract theory is postponed. Considerable space is de-

voted to applications involving only the use of the right-angled triangle; and identities occupy a subordinate position. The final chapter deals with complex quantities, Demoivre's theorem, and applications to analysis. The last hundred pages of the book are taken up with logarithmic and other tables, calculated to five figures. The first-rate quality of the type employed deserves special mention.

OUR BOOKSHELF.

Experimental Studies in Electricity and Magnetism. By F. E. Nipher. Pp. 73. (Philadelphia: P. Blakiston's Son and Co., 1914.) Price 1·25 dollars net.

THIS book consists mainly of descriptions of the author's experimental work, and summarises his reasons for accepting the one-fluid theory of electricity. Photographs of discharges across a spark-gap, and traces on a photographic plate due to discharges over its surface, constitute the major part of the evidence. Much work has been done, and many interesting plates are reproduced, but it is doubtful whether the experiments are quite so conclusive as the author believes. Several novel ideas are introduced, such as the existence of conducting lines or "drainage channels" round the positive or "exhaust" electrode in every kind of discharge, though it might be pointed out that this idea of a well-conducting channel is scarcely compatible with the considerable potential-slope which exists in the positive column of a discharge tube. The suggestion that gravitational attraction is due solely to the "corpuscular nebula" which permeates all matter is also novel; it is used to explain the explosive effect of discharging a Leyden jar through a wire.

Loosely-worded expressions as "the corpuscular nebula is set into a rhythmical vibration" abound, and the phraseology generally is scarcely so precise as that usually found in scientific publications. It is possible that the case made out by the author suffers considerably from the manner in which it is presented, but certainly simpler explanations than those given would seem to suffice for some of the phenomena mentioned. The deflection of a magnetic needle due to a gust of wind might conceivably be due to a magnetic storm produced by the wind, but it would be advisable to see that the oscillation box is hermetically sealed or even evacuated, before accepting the magnetic storm hypothesis!

The Principles and Practice of Judging Live Stock. By Prof. C. W. Gay. Pp. xviii+413. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1914.) Price 6*s.* 6*d.* net.

THIS volume is a very full compendium of all that belongs to a practice which has almost become a fetish in American agricultural colleges. To the student is given a card on which are printed the sections into which a horse, or some other animal, may be divided, and the marks to be awarded to each section. A draught horse, for instance, is divided into forty sections, and, as the marks total to 100, most sections get very small and none very large marks. The marks for some of the most important parts are these, given shortly: hocks, 6; hind cannons, 2; hind fetlocks, 2; hind pasterns, 3; hind feet, 4; hind legs, 4; walk, 6; trot, 4.

Some of us who have tried it would have been exceedingly glad had this volume contained some evidence as to the educative value of the score card, because it may be doubted whether good judges are produced by its use; and because it fails to make sufficient distinction between the good and the supremely good, or the fair and the useless animal. All this, however, is rather a criticism of the system, or at any rate, of the scale of marks.

If the system be admitted good and useful, Prof. Gay's book is also good and useful. It contains good illustrations, descriptions of many breeds, an appendix containing the card marks for different breeds, and much information as to yields of milk, butter, beef, wool, and so on.

J. W.

The Elements of Electro-Plating. By J. T. Sprague. Pp. vii+72. (London: E. F. N. Spon, Ltd., 1914). Price 1*s.* 6*d.* net.

THE publication of this little volume brings home to us the sparseness of literature on the subject of electro-plating. Its publishers have considered it worth while to re-publish, in this form, the intensely practical and well-written chapter dealing with the practice of the electro-deposition of metals which originally appeared in the late Mr. J. T. Sprague's "Electricity: Its Theory, Sources, and Applications." This classic was one of the best books of its kind when originally written, and the chapter on electro-plating was one of the best parts of the book. It is true that it is addressed "rather to experimentalists, students, and general readers" than to those "mainly intent on business considerations," and it is also true that as good electro-plating was done twenty-five years ago as now; yet one cannot but feel that the publishers would have done better to publish a new book than to re-publish an old one when dealing with a practical application of electricity. The reprint bears the new date 1914, and not the date of original publication, but perhaps some of our older readers may be able to make a rough guess at the latter from the clue given by the following passage: "It is impossible to urge too strongly, alike upon the learner and the practical operator, the advantage of keeping in circuit a suitable galvanometer . . . and galvanometers to show current in amperes are now easily obtainable." The book, old as it is, contains valuable directions and recipes, and if, instead of merely reprinting it, the publishers had employed a practical man of to-day to revise and re-write it, they would have deserved our unstinted commendation.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Supposed Horn-Sheaths of an Okapi.

MR. R. LYDEKKER, F.R.S., lately directed attention in the columns of NATURE to a specimen of the okapi sent home by Dr. Christy from the Congo State, which was stated to be provided with corneous sheaths to its horns, resembling those of an antelope. The specimen has been mounted by Mr. Gerrard, of Camden Town, and is still in his workshop, whilst the skull has been purchased by the Royal College of Surgeons. I have been given the opportunity of examining both the mounted skin and the skull. The skull is of an individual of nearly the same size and age as that presented to the Natural History Museum by the late Captain Boyd Alexander, carefully figured under my superintendence with many other skulls of the okapi in the atlas of my "Monograph of the Okapi," published in 1910 by the trustees of the British Museum. With the new skull acquired by the College of Surgeons, and apparently belonging to the same animal as the skin, is a pair of small ossicones, not yet ankylosed to the skull, measuring about 2 in. along the longer side from point to base. They are of the same shape and little shorter than those of Boyd Alexander's specimen. In neither skull is there as yet a tuberculated surface of the frontal bone developed for the attachment of the ossicone. In the Boyd Alexander specimen each ossicone stood up as a projecting cone, and was covered with the hairy skin except for a small area at the free end, where the hair seems to have been rubbed away, or removed in preparing the skin, as may be seen in the mounted specimen in the Natural History Museum. In Major Powell-Cotton's specimen, of which both skin and skeleton are in the museum, each ossicone is longer, slightly compressed from side to side, and claw-like in shape, the point curved downward and backward; and each ossicone rests on a pitted and tuberculated surface of the frontal bone, to which it is closely fitted but not yet ankylosed.

In older specimens, *e.g.* that in Paris and that in Edinburgh, figured in my atlas, there is complete ankylosis of the ossicone with the frontal bone, and a wide extension of its base. The ossicones of the Powell-Cotton specimen are $3\frac{3}{4}$ in. in length, and are closely covered with hairy skin except, for a length of about $\frac{1}{4}$ in., at the tip, which pierces the skin. This "tip" of the okapi's horn, or ossicone (not yet developed in the Boyd Alexander specimen), consists, as I have described in the Proc. Zool. Soc., 1907, of peculiarly dense bony substance, which acquires a bright polished surface, and is sharply marked off like a nipple, by its raised margin from the rest of the bony substance of the ossicone, as seen in all adult specimens, of several of which I have published drawings. It emerges through the skin as a tooth does, when it is said to be "cut."

It is only in their pointed claw-like shape and the penetration of the skin by the hard, tooth-like apex that the okapi's paired ossicones differ from the paired ossicones of the giraffe. It is, however, remarkable that the fœtal giraffe has already before birth two soft hair-covered growths corresponding in position and proportionate size to the paired ossicones of the adult, and that the bony ossicones develop in these soft upstanding structures soon after birth. The young okapi has no such tegumentary growths, and the ossicone makes its appearance when the animal is nearly full grown or completely so as a free button-like ossification lying beneath the integument, which is pushed upwards by it as it grows. The dense emerging point of the okapi's ossicone forms for the animal a very efficient weapon. The giraffe's ossicone never penetrates the skin, but its apex is broad and flat and clothed with a tuft of long black hair. The axis of the okapi's ossicone is not at right angles to the horizontal plane of the skull, but is directed backwards so as to form an angle of 45° with that plane.

Mr. Gerrard tells me that wrapped in the bundle with the skin of Dr. Christy's specimen as received by him were two hollow, bluntly ending corneous horn-sheaths of about $2\frac{1}{2}$ in. in length, which he was led to suppose belonged to the animal. He has mounted these two hollow horn-sheaths on the top of the animal's head over the holes in the skin made in originally clearing it from the ossicones (when the skin was prepared in Africa) which have gone with the skull to the College of Surgeons. These hollow horns do not fit well to the cut skin, and there is no intrinsic evidence forthcoming to justify the association of them with the okapi's skin. They have the appearance of young horn-sheaths of some species of antelope, and show a few ring-like markings on the surface. They taper only slightly from base to tip, and the tips are rounded and blunt. It is, I admit, conceivable that in the early period of its growth before the completion of its ivory-like point and the cutting by it of the skin, the ossicone of the young okapi might develop a temporary corneous sheath to be shed during further growth and replaced by hairy skin. The prongbuck sheds its horn-sheath yearly, and very young cavicorns have been observed to shed a first sheath before acquiring a permanent one. Hence it is not impossible that a temporary corneous sheath should develop from the skin covering the young ossicone of the okapi.

The real question in such a matter is what is the evidence in favour of the unlikely but possible occurrence? The fact that between fifty and a hundred skins and skulls of the okapi have reached Europe in the last twelve years, and that no such horn-sheaths have hitherto been seen or heard of, is important. It is also important to bear in mind that it is quite certain that when once the okapi is full grown and its ossicone is ankylosed to the skull, it is covered by hairy skin like that covering the skull, from which its naked ivory-like point emerges.

The evidence is as follows. Mr. Gerrard tells me that he was led to believe that the small horny sheaths sent with the skin of the okapi actually belonged to the specimen by the fact that when removed from the parcel a label was found tied to them on which was written, "Horns of the Okapi." This would certainly seem to justify Mr. Gerrard in mounting them on the head, as he did.

He has, however, since I saw the specimen, sent me a note just received by him from Dr. Christy. This is headed, "Details of Okapis obtained with numbers of cases and dates of dispatch." It is signed by Dr. Christy, and dated Khartoum, February 10, 1915. It appears that Dr. Christy has been employed on a mission in the Congo State during 1913–14 by the Belgian Government, and that he had forwarded during those years specimens collected by him to Brussels to be sent on to Mr. Gerrard, acting as his agent, in London. Seven specimens of okapi are mentioned in the list before me, and the date of shooting and the name of the ship and route by which they were dispatched are given. Some were sent off in 1913, others in 1914. Mr. Gerrard tells me that only one—the one he has mounted—has reached him in

London. It is impossible to say whether the others arrived in Brussels, and, if so, what has now become of them. Dr. Christy's list is a very interesting one, and I will venture to give extracts from it. The specimens are distinguished by numbers. "No. 507, ♂ juv., not full grown; shot by myself, April 10, 1913. Skin good, skeleton complete." "No. 531, ♂, full grown. Shot by a Congo official, out shooting with me, May 22, 1913. Horns 1¼ in., skin-covered. Skin good, skeleton complete." "No. 686, ♀, big. Shot by myself, October, 25, 1913. Skin good, skeleton complete." "No. 717, ♂, old. Shot by Reid. Skin good; horns and hoofs attached to skin. Skeleton complete. Horns 4 or 5 in. long, and bare at tips." "No. 532, ? ♂. Skin only: from natives." "No. 533, ? ♀. Skin only; from natives." "No. 695, juv., ? sex; half-grown, 1913. Skin dried by natives. Skeleton complete."

In this list it will be observed that nothing is said about "horn-sheaths." It is perfectly certain that, as a sportsman and naturalist acquainted with the okapi, and the only "educated" European who has himself shot the okapi, Dr. Christy would have directed attention in his notes to the presence of "horn-sheaths" if he had discovered such structures to exist.

Only one of the seven specimens mentioned in Dr. Christy's list has come through to London. I have no doubt that it is the specimen No. 531, shot on May 22, 1913, at Mawambi, by a Congo official out shooting with Dr. Christy. The horns (ossicones) are stated definitely to be *skin*-covered. This agrees with my inference from a comparison with the Boyd Alexander specimen and the state of growth of the ossicones. It makes the "horny-sheaths" impossible. The measurement given by Dr. Christy for the horns (ossicones) is 1¼ in. This is their vertical height from base to apex. As they are pyramidal in shape, the measurement along the side of the pyramid from apex to edge of the expanding base, is as given above by me, about 2 in.

I think that Dr. Christy's own notes settle the question against the horny sheaths which it was already really impossible to "fit" satisfactorily to the specimen with which they reached Mr. Gerrard.

As to how this label—with "Horns of the Okapi" written on it—became attached to these little horn-sheaths it is possible to form various conjectures. Perhaps some busy, well-intentioned servant, being told to be sure to see that the little horns (ossicones) were not omitted from the parcel, mistakenly picked up the small horn-sheaths belonging to some antelope skin, left by chance with other skins and skulls in the disorder of packing or preparing a mass of specimens, and conscientiously but erroneously labelled them "Horns of Okapi," and packed them with specimen No. 531, destined to produce astonishment and confusion on arriving two years later in London.

Dr. Christy is to be congratulated on the fine series of specimens of okapi which he obtained and sent to Brussels *en route* for London. We must hope that they may escape destruction or seizure by the enemies of mankind, and eventually yield their contribution to our knowledge of the okapi, especially since among them are the first specimens seen alive and shot by a competent European observer.

March 9. E. RAY LANKESTER.

The Spectra of Hydrogen and Helium.

MR. E. J. EVANS has described recently some interesting experiments on the "4686" and Pickering series, which were obtained from vacuum tubes containing helium from which hydrogen was apparently completely eliminated. Stark has also observed the "4686" line in a vacuum tube showing no trace of the hydrogen lines. The experimental evidence of a helium origin of the lines in question would thus appear to be strong, and Prof. Fowler, from analogy with the enhanced line series of the alkaline earths, has also concluded that the lines are due to helium. According to Dr. Bohr, who first suggested that the lines were due to helium, the series in question owe their origin to the binding of an electron by a helium atom from which two electrons have been removed. Dr. Bohr's theory involves a modified value of Rydberg's constant for these lines, and Prof. J. W. Nicholson, in a letter to NATURE of February 11, has pointed out that it can be put to the test by an accurate measurement of the lines of the "4686" series, from which the value of the constant can be calculated.

Although the spectroscopic evidence is in favour of helium as the origin of the lines, it may be pointed out that this evidence is not conclusive. Although 4686 does not appear in hydrogen in the absence of helium, the same may be said of ultra-violet members of the Balmer series, which do not appear in vacuum tubes containing pure hydrogen, but which make their appearance when helium is present. The difficulty of preparing vacuum tubes free from hydrogen is well known, and the fact that the ordinary hydrogen lines are absent from the spectrum cannot be taken as conclusive evidence that hydrogen is not present. In view of this fact, the writer has conducted experiments to determine the relative mass of the atom from which the "4686" series originates, by measuring the limits of interference of the "4686" line and the lines of helium and hydrogen. The circumstances which control the breadth of spectrum lines have been discussed by Lord Rayleigh in the current number of the *Philosophical Magazine*.

At low pressures the order of interference at which fringes are still visible is proportional to the square root of the atomic weight of the atom from which the radiation originates. It is hoped shortly to publish a full account of the experiments, but the following may be stated as a preliminary result. A vacuum tube containing helium and hydrogen at a low pressure was excited by an induction coil with capacity and a spark-gap in the circuit, the spectrum consisting of helium lines, 4686, and the hydrogen lines. With an interference apparatus giving a suitable difference of path, moderately sharp ring systems can be obtained for all the helium lines, whilst no trace of interference can be detected in the 4686 line or the hydrogen lines.

Further observations are required to determine the exact limits of interference of the 4686 line and the hydrogen lines, but the results indicate that the mass of the atom from which 4686 originates is definitely smaller than that of the atoms concerned in the production of the ordinary helium spectrum.

T. R. MERTON.

University of London, King's College, March 15.

Musical Sand in China.

AMONG the immense mass of ancient Chinese records and manuscripts brought back from the buried cities and caves of ancient Khotan, in Central Asia, and now stored in the British Museum, is one called the Tun-Huang-Lu, a topographical description of part of Khotan itself. This little geography was written in the time of the Tang dynasty, in the seventh century, but probably contains matter from earlier authors.

Among the specially interesting natural phenomena of the country described in the Tun-Huang-Lu is a large sandhill, which at certain times gave forth strange noises, so much so that a temple in its vicinity was entitled the "Thunder Sound Temple."

The geographer, speaking specially of the sandhill, says:—"The hill of sounding sand stretches 80 li east and west and 40 li north and south. It reaches a height of 500 ft. The whole mass is entirely constituted of pure sand. In the height of summer the sand gives out sounds of itself, and if trodden by men or horses, the noise is heard 10 li away. At festivals people clamber up and rush down again in a body, which causes the sand to give a loud rumbling sound like thunder. Yet when you look at it next morning the hill is just as steep as before."

Mr. Lionel Giles, from whose translation of the Tun-Huang-Lu these extracts are made, mentions that this sounding sandhill is referred to in another old Chinese book, the Wu Tai Shih.

JOSEPH OFFORD.

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The Green Flash.

I CAN confirm Dr. Schuster's observation of the green flash at sunrise, as in September last I saw a green segment herald the sun as it rose from the sea into a sky which was free from atmospheric glare (see the *Observatory*, December, 1914). Observations had previously been made at sunset, in one of which the eye was unquestionably fatigued, and the green flash was seen upon turning *away* from the sun at the instant after sunset. In a later sunset experiment precautions were taken to prevent retinal fatigue, and again the flash was seen.

My opinion is confirmed by Prof. Porter's experiment that "the reason why doubt has been cast upon records of the green flash is that the colour may arise in two different ways (complementary colour due to retinal fatigue, or dispersion by the atmosphere), and that the observer has not always been careful to avoid retinal fatigue, as was the case in my first (sunset) observation."

My observation, No. 2 (*loc. cit.*), is also in agreement with Dr. Schuster's experience, that with a very red sun no flash is to be seen.

W. GEOFFREY DUFFIELD.

University College, Reading, March 6.

Measurements of Medieval English Femora.

As the Editor of NATURE has insisted upon the great pressure at present upon his space I propose to reply to Dr. Parsons's letter, in the issue of March 11, adequately elsewhere. KARL PEARSON.

Galton Laboratory, March 15.

THE PRINCIPLE OF SIMILITUDE.

I HAVE often been impressed by the scanty attention paid even by original workers in physics to the great principle of similitude. It happens not infrequently that results in the form of "laws" are put forward as novelties on the basis of elaborate experiments, which might have been predicted *a priori* after a few minutes' consideration. However useful verification may be, whether to solve doubts or to exercise students, this seems to be an inversion of the natural order. One reason for the neglect of the principle may be that, at any rate in its applications to particular cases, it does not much interest mathematicians. On the other hand, engineers, who might make much more use of it than they have done, employ a notation which tends to obscure it. I refer to the manner in which gravity is treated. When the question under consideration depends essentially upon gravity, the symbol of gravity (g) makes no appearance, but when gravity does not enter into the question at all, g obtrudes itself conspicuously.

I have thought that a few examples, chosen almost at random from various fields, may help to direct the attention of workers and teachers to the great importance of the principle. The statement made is brief and in some cases inadequate, but may perhaps suffice for the purpose. Some foreign considerations of a more or less obvious character have been invoked in aid. In using the method practically, two cautions should be borne in mind. First, there is no prospect of determining a numerical coefficient from the principle of similarity alone; it must be found if at all, by further calculation, or experimentally. Secondly, it is necessary as a preliminary step to specify clearly *all* the quantities on which the desired result may reasonably be supposed to depend, after which it may be possible to drop one or more if further consideration shows that in the circumstances they cannot enter. The following, then, are some conclusions, which may be arrived at by this method:—

Geometrical similarity being presupposed here as always, how does the strength of a bridge depend upon the linear dimension and the force of gravity? In order to entail the same strains, the force of gravity must be inversely as the linear dimension. Under a given gravity the larger structure is the weaker.

The velocity of propagation of periodic waves on the surface of deep water is as the square root of the wave-length.

The periodic time of liquid vibration under gravity in a deep cylindrical vessel of any section is as the square root of the linear dimension.

The periodic time of a tuning-fork, or of a Helmholtz resonator, is directly as the linear dimension.

The intensity of light scattered in an otherwise uniform medium from a small particle of different refractive index is inversely as the fourth power of the wave-length.

The resolving power of an object-glass, measured by the reciprocal of the angle with which it can deal, is directly as the diameter and inversely as the wave-length of the light.

The frequency of vibration of a globe of liquid, vibrating in any of its modes under its own gravitation, is independent of the diameter and directly as the square root of the density.

The frequency of vibration of a drop of liquid, vibrating under capillary force, is directly as the square root of the capillary tension and inversely as the square root of the density and as the $1\frac{1}{2}$ power of the diameter.

The time-constant (*i.e.*, the time in which a current falls in the ratio $e:1$) of a linear conducting electric circuit is directly as the inductance and inversely as the resistance, measured in electro-magnetic measure.

The time-constant of circumferential electric currents in an infinite conducting cylinder is as the square of the diameter.

In a gaseous medium, of which the particles repel one another with a force inversely as the nth power of the distance, the viscosity is as the $(n+3)/(2n-2)$ power of the absolute temperature. Thus, if $n=5$, the viscosity is proportional to temperature.

Eiffel found that the resistance to a sphere moving through air changes its character somewhat suddenly at a certain velocity. The consideration of viscosity shows that the critical velocity is inversely proportional to the diameter of the sphere.

If viscosity may be neglected, the mass (M) of a drop of liquid, delivered slowly from a tube of diameter (a), depends further upon (T) the capillary tension, the density (σ), and the acceleration of gravity (g). If these data suffice, it follows from similarity that

$$M=\frac{Ta}{g}F\left(\frac{T}{g\sigma a^2}\right),$$

where F denotes an arbitrary function. Experiment shows that F varies but little and that within somewhat wide limits may be taken to be 3·8. Within these limits Tate's law that M varies as a holds good.

In the Æolian harp, if we may put out of account the compressibility and the viscosity of the air, the pitch (n) is a function of the velocity of the wind (v) and the diameter (d) of the wire. It then follows from similarity that the pitch is directly as v and inversely as d, as was found experimentally by Strouhal. If we include viscosity (ν), the form is

$$n=v/d.f(\nu/vd),$$

where f is arbitrary.

As a last example let us consider, somewhat in detail, Boussinesq's problem of the steady passage of heat from a good conductor immersed in a stream of fluid moving (at a distance from the solid) with velocity v. The fluid is treated as incompressible and for the present as inviscid, while the solid has always the same *shape* and presentation to the stream. In these circumstances the total heat (h) passing in unit time is a function of the linear dimension of the solid (a), the temperature-difference (θ), the stream-velocity (v), the capacity for heat of the fluid per unit volume (c), and the conductivity (κ). The density of the fluid clearly does not enter into the question. We have now to consider the "dimensions" of the various symbols.

Those of a are (Length)^1,
$\ldots\ldots v$ . . (Length)^1 (Time)$^{-1}$,
$\ldots\ldots \theta$ . . (Temperature)^1,
$\ldots\ldots c$ . . (Heat)^1 (Length)$^{-3}$ (Temp.)$^{-1}$,
$\ldots\ldots \kappa$ . . (Heat)^1 (Length)$^{-1}$ (Temp.)$^{-1}$ (Time)$^{-1}$,
$\ldots\ldots h$ . . (Heat)^1 (Time)$^{-1}$.

Hence if we assume

$$h=a^x\theta^y v^z c^u \kappa^v,$$

we have

by heat	$1=u+v$
by temperature	$0=y-u-v,$
by length	$0=x+2-3u-v,$
by time	$-1=-z-v;$

so that

$$h=\kappa a\theta\left(\frac{avc}{\kappa}\right)^z.$$

Since z is undetermined, any number of terms of this form may be combined, and all that we can conclude is that

$$h=\kappa a\theta.F(avc/\kappa),$$

where F is an arbitrary function of the one variable avc/κ. An important particular case arises when the solid takes the form of a cylindrical wire of any section, the length of which is perpendicular to the stream. In strictness similarity requires that the length l be proportional to the linear dimension of the section b; but when l is relatively very great h must become proportional to l and a under the functional symbol may be replaced by b. Thus

$$h=\kappa l\theta.F(bvc/\kappa).$$

We see that in all cases h is proportional to θ, and that for a given fluid F is constant provided v be taken inversely as a or b.

In an important class of cases Boussinesq has shown that it is possible to go further and actually to determine the form of F. When the layer of fluid which receives heat during its passage is very thin, the flow of heat is practically in one dimension and the circumstances are the same as when the plane boundary of a uniform conductor is suddenly raised in temperature and so maintained. From these considerations it follows that F varies as $v^{\frac{1}{2}}$, so that in the case of the wire

$$h\propto l\theta.\sqrt{(bvc/\kappa)},$$

the remaining constant factor being dependent upon the shape and purely numerical. But this development scarcely belongs to my present subject.

It will be remarked that since viscosity is neglected, the fluid is regarded as flowing past the surface of the solid with finite velocity, a serious departure from what happens in practice. If we include viscosity in our discussion, the question is of course complicated, but perhaps not so much as might be expected. We have merely to include another factor, ν^w, where ν is the kinematic viscosity of dimensions (Length)^2 (Time)$^{-1}$, and we find by the same process as before

$$h=\kappa a\theta.\left(\frac{avc}{\kappa}\right)^z.\left(\frac{c\nu}{\kappa}\right)^w.$$

Here z and w are both undetermined, and the conclusion is that

$$h=\kappa a\theta.F\left\{\frac{avc}{\kappa},\ \frac{c\nu}{\kappa}\right\},$$

where F is an arbitrary function of the *two* variables avc/κ and $c\nu/\kappa$. The latter of these, being the ratio of the two diffusivities (for momentum and for temperature), is of no dimensions; it appears to be constant for a given kind of gas, and to vary only moderately from one gas to another. If we may assume the accuracy and universality of this law, $c\nu/\kappa$ is a merely numerical constant, the same for all gases, and may be

omitted, so that h reduces to the forms already given when viscosity is neglected altogether, F being again a function of a single variable, avc/κ or bvc/κ. In any case F is constant for a given fluid, provided v be taken inversely as a or b. RAYLEIGH.

PERISCOPES.

WHILE the periscope of the submarine is developing in the direction of greater optical perfection and elaboration, there has been a return to the simplest and earliest types of periscope for use in land warfare. Some of these trench periscopes recall the polemoscope, described by Helvelius in the seventeenth century for military purposes; this polemoscope in its simplest form consisted of two mirrors with their reflecting surfaces parallel to each other, and

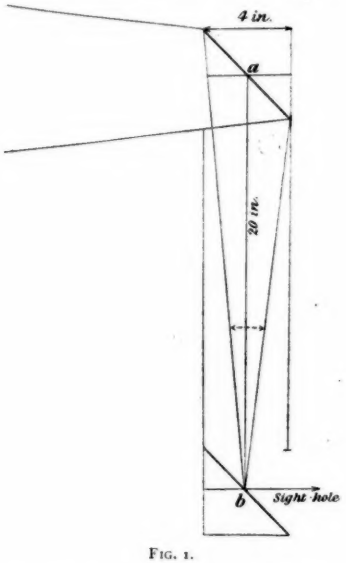


FIG. 1.

inclined at 45° to the direction of the incident light. These mirrors were mounted in a tube and separated a convenient distance (Fig. 1).

For modern trench warfare the convenient separation is about 18 to 24 in., and the mirrors are mounted in tubes, in boxes of square or oblong section, or attached to a long rod. In each case it is necessary that the mirrors should be fixed at the correct angle, and that there should be no doubling or distortion of the image.

The principal requirements of these trench periscopes are portability, lightness, small size and inconspicuous appearance, and large field of view. When there are no lenses the field of view is exactly the same as would be obtained by looking through a tube of the same length and diameter. Thus, with mirrors of 2 in. by 3 in. and a separation of about 22 in., a field of view of 5° would be obtained; and by moving the eye about, this field could be nearly doubled.

By using a box of oblong section the horizontal field of view can be increased without unduly increasing the size of the periscope. As the field of view is somewhat limited in any case, the principal objection to the use of a telescope or binocular, viz., the reduced field, no longer applies, and many periscopes are arranged to be used with a monocular or a binocular telescope.

Most periscopes can be used with a magnification of two or three, *i.e.*, with one tube of an ordinary opera glass; but when higher magnification is to be used the mirrors must be of better quality, both as regards flatness of surfaces and parallelism of the glass. When the mirrors are large enough—8 to 10 centimetres wide—both telescopes of the binocular may be used, but in this case the requirements for the mirrors are even more stringent, as the images formed by the two telescopes will not coincide unless the mirrors are plane. When suitable lenses are placed between the mirrors, the size of the mirrors can be reduced or the field of view increased; it is easy to provide a small magnification of the image or even to arrange for a variable magnification.

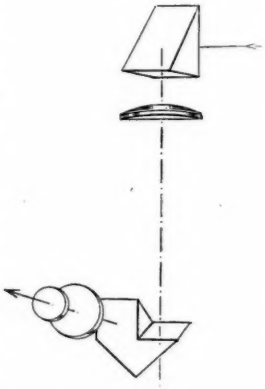


FIG. 2.

In such cases the lenses must be arranged to give an erect image, or mirrors or prisms employed to erect the image. An example of a periscope of this type is shown in Fig. 2, where the mirrors are replaced by reflecting prisms, and the prisms erect the image in much the same way as the prisms of a prism binocular.

This arrangement is very suitable for a large magnification, but for larger fields the prism is unsuitable, unless it be silvered, and it is preferable to erect the image by means of lenses.

When longer tubes are used or larger fields are required, the design should approximate to that used in the submarine periscope.

This optical system has been steadily developed since its first introduction by Sir Howard Grubb in 1901.

The system consists of two telescopes, of which one is reversed, so that the image would be reduced in size, while the other magnifies this image, so that the final image is of the same size as the object, or is magnified one and a quarter or one and a half times. (As a very large angular field of view is required in these periscopes, the beam reflected into the tube must cover a large angle, and would soon fall on the sides of the tube; the reversed telescope, however, reduces the angle of the beam, and so enables it to pro-

ceed far enough down the tube to be received by the second telescope, and so transmitted to the eye.)

In modern submarines the tube has a length of from 16 to 24 ft., the diameter is from 6 to 9 in., while the field of view is about 65°. In order that objects shall look their real size, it is necessary to give a magnification of one and a quarter to one and a half.

Fig. 3 gives an illustration of a periscope in which three telescope systems are employed. The drawing is made from information published by Messrs. Goerz[1] of Berlin, and relates to periscopes made by them. It is, of course, undesirable to give any details of English periscopes at the present time.

An outer tube has a spherical glass cover. In the inner tube is the optical system, which can be rotated to face in any required direction; the eye piece, however, remains fixed.

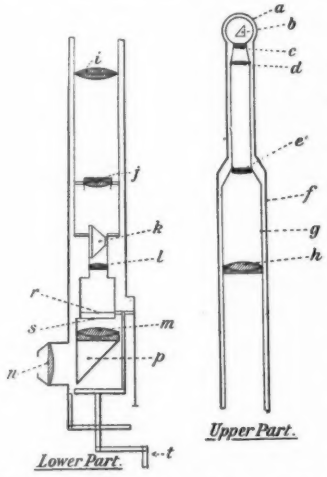


FIG. 3.—*a*, Glass cover; *b*, prism; *c*, *d*, and *e*, lenses of reversed telescope; *f*, outer tube; *g*, inner tube; *h*, *i*, and *j*, lenses of second telescope; *k*, reversing prism; *l*, *m*, and *n*, lenses of third telescope; *p*, prism; *r* and *s*, pointer and scale; *t*, rotating mechanism.

The optical system, which follows in its general principles Sir Howard Grubb's original design, consists of:—

(1) A reversed telescope, giving a reduction of about one quarter;

(2) A telescope, giving a magnification of about two;

(3) An erecting prism which can be rotated so that the image given by the system is correctly oriented;

(4) A telescope giving a magnification of about three.

This telescope includes a fixed eye piece and prism, so arranged that the observer looks horizontally at the object. At the focus of the eye piece are placed a scale and pointer to show the bearing of the object sighted, and a ruling to allow the distance to be estimated when the size of the object is known.

By the aid of a subsidiary system, special parts of the field can be further magnified to allow of objects being examined in more detail.

The continued use of the periscope is very trying to the eye, so that devices have been used to throw the image on to a ground glass screen. The ordinary eye piece and ground glass systems are made interchangeable, so that the observer can readily pass from one to the other; he may observe with the ground glass in the ordinary way, but examine special objects with the ordinary eye piece.

The field of view of the periscope is still limited, and various attempts to overcome this difficulty have been made. More than one periscope can be used and the images combined to form a complete image. A recent improvement consists in the use of a ring reflector which enables a view of the whole horizon to be obtained at once. The image formed by the ring system is much distorted, but when any object is picked up it can be examined by means of the ordinary system. These two optical systems are combined in one instrument, so that the two images are seen in the one field, the image formed by the ring system surrounding the other.

But these ring periscopes are still far from perfect, their distortion making it very difficult to identify objects; and this difficulty, though not so pronounced, occurs with the ordinary periscope. The point of view from which the surface of the sea and surrounding objects are seen is one to which the eye is not generally accustomed. The conditions of lighting, too, render it difficult to distinguish objects, especially when there is mist or spray, so that the effective use of a periscope requires considerable skill and training.

Trench periscopes may be obtained from most opticians, and the following are a few typical forms:—

The Hampson, wooden stake carrying two mirrors; price 7*s.* 6*d.*

The Adams, jointed rod; price 10*s.* 6*d.*

The Stanley; the support is in the form of lazy tongs, and is of a light alloy; price 25*s.*

These open-mirror types are light, portable, with good field, but the mirrors are not protected from rain, and the useful field is surrounded by bright sky.

Tube types are made by Messrs. Negretti and Zambra, Dixey, The Periscope Co., and many others; prices from 8*s.* 6*d.* to 15*s.*, depending on the metal tube used. In these types the field is rather limited.

Messrs. Chas. Baker and Co. supply a type with large mirrors, which can be satisfactorily used with both barrels of a binocular. In spite of the large mirrors, the type is very portable; price 30*s.*

Many makers supply types in which the optical system is incorporated with the periscope, and the prices of these range from 28*s.* to 6*l.* 10*s.*, according to the type of optical system used.

S. D. CHALMERS.

[1] Dr. Weichert, Jahrbuch der Schiffsbautechnischen Gesellschaft, 1914.

OIL OF VITRIOL AS AN AGENT OF "CULTURE."

IN a former article under this heading (NATURE, December 31, 1914, vol. xciv., p. 472) we pointed out that Germany's ability to continue the war depended largely upon her power to maintain her supply of oil of vitriol, this product being absolutely indispensable in the manufacture of

those high explosives upon which her artillery depends. We stated further that Germany's stock of the materials which are required to produce oil of vitriol is very limited, her sources of internal supply being almost negligible in comparison with the huge amounts demanded by her industries. An article by Dr. Reusch in a recent issue of the *Chemiker Zeitung* (vol. xxxviii., pp. 1241–43) is interesting at the present moment as showing that Germany is beginning to feel the pinch of necessity as regards this substance, and that, in view of the "reprisals" with which she is now threatened, as a consequence of her policy of "piracy and pillage," this necessity will become increasingly stringent.

We learn from Dr. Reusch's article that all export of sulphuric acid, sulphuric anhydride, and sulphurous acid from Germany is now prohibited. Before the war began she was a large importer of oil of vitriol—the imports in 1913 exceeding the exports by 65,289 metric tons—most of which came from Belgium. The total German production in 1912 is given as 1,649,681 metric tons, mostly made from pyrites, of which more than 80 per cent. was imported, mainly from Portugal, Spain, and France. Germany possesses deposits of this mineral, but they are of poor quality, and their working would present difficulties owing to scarcity of labour and other causes. She is now looking to Norway as a possible source, but if the policy indicated by Mr. Asquith is to be effective it should not be difficult to checkmate her action in this direction.

Another source of supply consisted in the working-up of zinc-blende, largely carried on in Silesia, principally on imported material, of which about 60 per cent. came from Australia alone. The only other main source would be natural sulphur imported through Italy, and principally of Sicilian origin, but here again, if the policy of "reprisals" is efficiently maintained, it should be readily possible for us to deal with this means of supply. It is interesting, in this connection, to note that in this respect, history repeats itself. During the Napoleonic wars the French occupied Sicily mainly with the view of cutting off our supply of sulphur for the manufacture of gunpowder in retaliation for our blockade of Pondicherry, upon which the enemy depended for his supply of nitre.

The sulphuric acid required for the manufacture of explosives is mainly employed in the production of nitric acid from nitrates, and from the point of view of hampering Germany in providing herself with the munitions of war it would be equally, if not more, effective to cut off her supplies of nitrates. As regards imported nitrates, and particularly Chile saltpetre, this may be practicable, and, indeed, cargoes of this material have already been stopped by our vessels on the high seas. But she has still certain internal sources of supply, as have most continental nations, and we now see that it is not for nothing that for some years past German chemists and engineers have, under the fostering influence of persons in high places, been straining every nerve to perfect possible synthetic processes of making ammonia and of converting it into nitric acid and nitrates, largely by the aid of the water-power of Norway.

Luckily for the Allies at the present juncture, certain of these processes, such as that of Ostwald, have turned out to be hopeless commercial failures, but there are others which would appear to have in them the promise of eventual and permanent success. We learn that the German Government has just introduced a Bill into the Reichstag providing for a State monopoly of the trade in nitrates for a period of seven years. The preamble explains that, at great expense, the Government has succeeded, in consequence of the stoppage of imports of Chile saltpetre, in establishing a chemical industry for the fixation of nitrates from the air, and that this industry is to be protected absolutely from all competition. Meanwhile, the price of nitrates, as of sulphuric acid, has steadily risen in Germany, and the shortage is becoming more and more pronounced. The process of depletion of sulphuric acid may be delayed by the action of the Government, which may be driven ultimately to commandeer all supplies in the interests of national defence. For the moment a certain amount is liberated in consequence of the diminished activity of various branches of chemical industry, as, for example, the dyestuff factories, and owing to the economy which has been enjoined in the manufacture of superphosphate manures, partly in consequence of the increased production of basic slag, due to the expansion of the iron industry. T.

PROF. H. W. LLOYD TANNER, F.R.S.

PROF. H. W. LLOYD TANNER, whose death on March 5 we announced with regret last week, was born at Burham, in Kent, on January 17, 1851. He received his school education at Bristol Grammar School, from which he proceeded to Jesus College, Oxford. At Oxford he came under the stimulating influence of Mr. John Griffiths, the mathematical tutor of his college. After leaving Oxford he held some educational appointments until the year 1883, when the University College of South Wales and Monmouthshire was founded at Cardiff. Of this college he was appointed Professor of Mathematics and Astronomy, and he occupied the chair at Cardiff until his resignation in 1909.

Cardiff University College now forms one of the constituent colleges of the University of Wales, but the Charter of the University was not granted until ten years after the opening of the college at Cardiff. In the interval the students of the college were prepared for the degrees of the University of London, and the courses of lectures in mathematics and other subjects were necessarily framed to meet the requirements of that University. After the foundation of the University of Wales the professors in the Welsh colleges enjoyed a degree of freedom in the choice and scope of the subjects they taught which had been denied to them when their students were reading for the

degrees of an external university. Prof. Tanner took an active part in the arrangement of the mathematical work of the Welsh University in the early days, and the courses of study in pure mathematics still show the great influence he exerted on the general character of the mathematical teaching in Wales.

At Cardiff Prof. Tanner made a reputation for himself as an inspiring teacher and an excellent administrator. When the British Association visited Cardiff in 1891 he acted as one of the local secretaries, and the success of the meeting was in a large measure due to the thoroughness with which the secretaries carried out the necessary arrangements. After the death of Principal Jones he filled for some time the position of Acting-Principal of the college. In the year 1909 his health broke down, and he resigned his appointment as professor. In recognition of his services as head of the department of mathematics for twenty-six years, the Council of the college appointed him Emeritus Professor of Mathematics and Astronomy.

Amid all his varying activities in connection with his work in college, Prof. Tanner found time to engage in mathematical research, and he published in the Proceedings of the London Mathematical Society a series of valuable papers. His early papers, the first of which was written in 1875, dealt with the solution of partial differential equations, but his later papers were mostly concerned with the theory of numbers. These later papers were remarkable alike for grasp of principle, clearness of exposition, and elegance of method. The Royal Society recognised the value of his research work by electing him a Fellow of the Society in 1899. The University of Oxford also honoured him by conferring on him the degree of D.Sc., and by appointing him on one occasion an examiner for mathematical scholarships.

R. H. P.

NOTES.

THE fifth annual May lecture of the Institute of Metals will be given on Wednesday, May 12, by Sir J. J. Thomson.

A SPECIAL lecture on the septic infection of wounds will be delivered before the Royal Society of Medicine on Tuesday, March 30, by Sir Almroth Wright, who will deal with the results of his investigations and research with the Expeditionary Force.

A CORRESPONDENT in Moscow informs us that the Imperial Society of Naturalists has removed the names of Prof. Haeckel and Prof. Ostwald from its list of members on account of their having signed the address, "To Civilised Nations," containing libels upon the Russian people.

THE death is announced, at eighty-six years of age, of Dr. W. M. Dobie, who was associated with Charles Kingsley in founding the Chester Society of Natural Science, Literature, and Art, and was president of the society during the sessions 1893–94 and 1894–95.

THE Board of Trade announces that in order to mitigate the effects of the dearth of indigo for dyeing purposes caused by the present war, and also to prevent any speculative holding up of natural indigo, the Government has acquired the greater part of the crop of natural indigo now coming forward for the use of dye-users in the United Kingdom.

THE *British Medical Journal* has received a communication from a distinguished Scandinavian colleague in which he expresses the opinion that the reception accorded to foreign medical visitors in this country compares unfavourably with that they habitually receive from the medical profession in Austria and Germany. In these countries the practice of the large hospitals is placed at the disposal of foreign visitors without fee, whereas here fees more or less large are generally charged. This doubtless depends partly on the fact that our hospitals are voluntary and the staff is unpaid, whereas abroad the hospitals are Government institutions. The Germanic countries are also indefatigable in flooding the Scandinavian countries with their medical literature, while England and France, on the other hand, send scarcely a book for review to the Scandinavian countries. Here seems to be another opportunity for the extension of British enterprise.

DR. BATSCHINSKI, of the University of Moscow, informs us that Prof. Nicolas Oumoff, whose death on January 15 was announced in these columns on January 28, was born at Simbirsk, East Russia in 1846. After passing through the University of Moscow he became lecturer and afterwards professor of theoretical physics at the University of Odessa. In 1903, after twenty-two years at Odessa, he was appointed professor of physics at the University of Moscow. Here, with the late Prof. Lebedew as his colleague, a large new physics institute was designed and erected. Prof. Oumoff was one of the Russian representatives at Lord Kelvin's jubilee, and received the honorary degree of LL.D. from the University of Glasgow. Along with many other Moscow professors, he resigned his position in 1911, and devoted himself to the Ledenzoff Society for assisting discoveries and inventions useful to humanity. He was very successful both as a university and as a popular lecturer. Of his published papers those on terrestrial magnetism are probably best known in this country.

THE death is announced, at seventy-nine years of age, of Sir George Turner, whose researches relating to rinderpest, leprosy, and other diseases in South Africa are of high importance. Sir George Turner entered the Civil Service of Cape Colony as medical officer of health in 1895. The year after, rinderpest broke out in the Cape Colony. Koch had just devised a system of inoculation against this disease of cattle, and after three weeks' collaboration with him, Sir George continued the work, and before long devised a method of producing a lasting immunity by simultaneous inoculation with virus and serum. Within a year rinderpest in Cape Colony was stamped out; later, the same method was adopted in Egypt and Natal. In the South African war, on the outbreak of

typhoid fever, he supervised the military hospitals and concentration camps. Afterwards he devoted his spare time to the leper asylum at Pretoria, and was assiduous in doing all he could to alleviate the lot of the inmates and in investigating the disease. On his retirement in 1907 he still continued his researches on leprosy in the laboratory, but after some years' work he noticed that he himself had contracted the disease which he had set himself to fight. Nevertheless, he still continued to work unswervingly amid the pain and beneath the shadow of a leper's lot.

THE arrangements which the Institute of Industry and Science (Aldwych Site, Strand, W.C.) has been making for some months past with regard to the holding of a conference in London of leaders of industry and science to discuss the British position, have now been completed, and a conference is to be held on Thursday, March 25, at the Mansion House. The proceedings will be opened with an address on the influence of science in political economy, to be followed by a discussion on the co-operation of science and industry. Many distinguished representatives of industry and science are expected to be present and to speak upon these and related subjects. A very effective organisation has already been created by the Institute of Industry and Science. At a meeting of the directors, held on March 10, it was resolved to place the organisation at the disposal of the Government without reservation, and this has already been done. A large number of the principal trade organisations are fully represented in the institute, and many eminent men of science and industry are taking an active part in its work. An important work, entitled "A Study of the First Principles of Production, and the Relation of Science to Industry," which has been in course of preparation for the last six months, by Mr. J. Taylor Peddie, will be published immediately by Messrs. Longmans, Green and Co., so as to be available before the conference. Attendance at the conference at the Mansion House is by invitation only.

IN the February number of the Journal of the Franklin Institute there is an interesting contribution by Dr. C. E. K. Mees under the title of "The Physics of the Photographic Process." He adopts Quincke's suggestion as to the sponge-like character of air-dried gelatine, with its cells and passages between them, and Joly's suggestion, which is confirmed by Nutting's calculation of the energy involved, that developable silver bromide is this salt which has lost one electron per grain (or particle). He thinks that reversal by the continued action of light is more likely due to the actual decomposition of the silver bromide, than to "self-neutralisation" brought about by the accumulation of the separated electrons in the gelatine surrounding the particles of silver bromide, as Joly and H. S. Allen have suggested, but we look in vain for any calculation as to whether the energy available is able to produce such a decomposition. He then considers the effects of the size of the grain, and states that a very fine-grained emulsion will never by cooking yield a very sensitive preparation. For this latter purpose one must *start* with a larger grain. In both cases sensitiveness increases as the grain grows. He considers, apparently favourably, the idea that greater sensitiveness is caused by the growth of the grain in size, and he illustrates by curves the effect of the gradation of grain size on the characteristic curve. An emulsion that is approximately homogeneous as to grain size gives a curve with a short "straight line" portion, while a larger proportion of smaller (less sensitive) grains, increases it, but a mixture of two emulsions, a low-speed fine-grained one with a high-speed, coarse-grained one, gives a very long under-exposure part to the curve. The author concludes with a short summary of recent work on the resolving power of plates.

PROF. J. STANLEY GARDINER, in lecturing on March 8 to the Royal Geographical Society on the geography of British fisheries, entered on a field which must have been as unfamiliar to most of his audience as it was interesting. After indicating the topography of the British fishing grounds, he illustrated the "correlation of habits with physical conditions" by discussing some of the remarkable facts in the growth, development, and movements of various food fishes which are gradually being brought to light. He mentioned the peculiar richness of the British fishing grounds as due largely to the quantity of organic remains derived from the land—indeed, he believed that drainage from the land would be found to be the "primary cause" of this richness, supplying the shallow seas with a substantial category of ingredients favourable to fish life. The varying character of the sea-floor, the movements of currents, and other phenomena were discussed as having important effects, some certain, some (so far as research has extended) no more than probable. Specially interesting was the reference to Dr. E. J. Allen's inquiry as to the relation between abundance of sunshine in early months of the year, the resultant rich cultures of diatoms, and the subsequent special abundance of copepods which feed on these, and of mackerel, which in spring feed largely on copepods. "We must regard as hopeful," he said, "the suggestion of physical data by which 'drifters' might be informed months beforehand of the probabilities of the fishery for the year."

PROF J. W. GREGORY, at a recent afternoon meeting of the Royal Geographical Society, discussed Suess's classification of Eurasian mountains. He contrasted it with other classifications, and commended it specially on the ground that "it separates the Himalayan line from the northern highlands, such as the Sayans, and from the north-eastern chains, such as the Yablonoi and Stanovoi mountains." Mountains widely different "in structure and geographical character," as these are, should be separated in classification, but Prof. Gregory stated that Suess did not always do this. He attached "excessive importance . . . to early earth movements which affected the foundations of the mountain areas," and his classification "does not serve ordinary geographical purposes, for it links together elements which are different in their topography and geographical influences, alike political, climatic, and biological; while it separates elements which have similar geographical influence." No doubt it was not primarily intended

to serve these purposes, but Prof. Gregory adduced purely physical reasons—elevation at the same epoch, due to great crustal compression, etc.—for classifying together the Pyrenees, Alps, Dinaric mountains, the Caucasus, Himalaya, and others, whereas Suess's classification "represents the Alps as closer akin to the hills of Brittany than to the Himalaya, and makes the Dinaric mountains and the hills of Crete the European equivalents of the Himalaya," and "is obviously not intended as a guide to the comparison of existing earth forms."

AMONG many valuable contributions to our knowledge of the natural history of Gloucestershire contained in the Proceedings of the Cotteswold Naturalists' Field Club for 1914 is the account of an excursion to the Forest of Dean and a description of the work being done by the School of Forestry. Works have recently been erected containing a retort of large capacity for the carbonisation of wood, and the necessary plant for producing and working up charcoal, grey acetate of lime, miscible naphtha, and wood-tar. Mr. Hanson, a member of the school staff, among other interesting facts, remarked that after diligent search in the forest only fifteen mistletoe plants have been found, eight of which were on poplar trees and none on oak. This, he observed, tends to confirm the belief that the connection between the oak and the mistletoe in Druidic times is more mythical than real. He fails, however, to observe that it is the comparative scarcity of the appearance of mistletoe on the oak which would be likely to inspire a belief in its sanctity.

NEW material has enabled Mr. C. C. Mook (Ann. New York Ac. Sci., vol. xxiv., pp. 19–22) to formulate the distinctive features of Camarosaurus, described by Cope in 1877, and one of the first of the sauropod dinosaurs made known to science. It is now shown that Morosaurus, named by the same palæontologist about a month later, is really inseparable. It is also recalled that at first Cope believed these huge and unwieldy reptiles to be bipedal.

A LONG synopsis, illustrated by eight plates, of the British fleas, or Siphonaptera, by the Hon. N. C. Rothschild, renders the March number of the *Entomologist's Monthly Magazine*, about double the normal size, and the price is consequently raised in proportion to all save subscribers. It is the first attempt to bring a difficult subject up to date, and is consequently to some extent tentative. The descriptions are purposely brief, and the diagnoses of genera and species apply only to the British forms. The author remarks that in a considerable number of cases the same species of flea infests totally different kinds of animals, and that Carnivora frequently acquire such unwelcome guests from their prey, and may apparently retain them for a considerable time.

THOUGH the Scottish Zoological Park, near Edinburgh, has suffered from the effects of the war, it has been found possible to undertake during the winter several new works. The largest of these is the acclimatisation house, presented by Lord Salvesen, president of the society. Another is the construction of a pool for the society's valuable collection of penguins, which arrived from the Antarctic last spring. The pool is almost completed, and the penguins will be seen to much greater advantage than hitherto. The completion of the polar bear pool has also been undertaken. The formation of the polar bear pool was the first work undertaken by the society in the laying out of the park, but as it was not possible to have the pool, as originally designed, completed in time for the opening in 1913, a temporary barrier and cages were thrown across one side, so that the bears might be exhibited at once. The temporary wooden barrier has now been removed, and the rock on one side is being cut back, in order to enlarge the pool and at the same time afford a rock face of sufficient height to prevent the escape of the bears. The work on this pool will also be completed in a short time.

WE have been favoured with a copy of a richly illustrated memoir on the "Anthracolithic Faunæ of Kashmir, Kanaur, and Spiti," by Dr. C. Diener, published as vol. v., No. 2, of the new series of the "Palæontologica Indica." Fossils of a Permo-Carboniferous type were brought to light many years ago by Col. Godwin-Austen and others in Kashmir; and in the late 'seventies a fresh deposit of such fossils was discovered by Mr. Lydekker. The latter proved to be of the same type as those from the well-known Kuling shales of Spiti, and were therefore classed as Permian, while the great bulk of the fossiliferous deposits were originally regarded as Carboniferous; a third horizon, of presumed Carboniferous age, being indicated by a quartz-sandstone from Ladak containing a brachiopod first described by Dr. Diener as *Spirifer lydekkeri*, but now transferred to the genus Syringothyris. More important was the subsequent discovery by Dr. Noetling of plant-remains of a Gondwana type in the Kashmir beds. Dr. Diener's original memoir on the Anthracolithic series was published in 1899; the present one is based on new stratigraphical work and new collections, and contains descriptions of new species and revisions of others. As the results of his work, the author considers that the fossil evidence proves the Zewan beds of Kashmir to be the equivalent of the Upper Productus Limestone of the Punjab Salt Range and the Kuling Shales, this being confirmed by the presence in all of two distinctive Permian species.

DR. A. SMITH WOODWARD has written for the British Museum (Natural History) an inspiring illustrated "Guide to the Fossil Remains of Man in the Department of Geology and Palæontology," price 4*d*. Since the remains in other collections are here represented by casts, a comprehensive view can be obtained of the remarkable additions to our knowledge of human origins that have been made in the last eight years. One of the most interesting pictures is that showing the side aspect of the Piltdown skull, in comparison with that from La Chapelle-aux-Saints (Neandertal type) and with a modern human skull. Equally effective drawings are given of the skulls of chimpanzees, in young and adult stages. The possession of a complete skeleton of the Neandertal type has enabled M. Marcellin Boule to furnish a valuable

comparison with that of the more erect modern Australian. The Piltdown type is regarded as even older than that represented by the mandible found at Mauer, near Heidelberg, in 1907. In stating that the immediate predecessor of modern man in Europe was of Neandertal type, Dr. Smith Woodward does not exclude the possibility of the contemporaneous existence of a type with less retreating forehead. The Transactions of the Perthshire Society of Natural Science (vol. vi., 1914) contain a paper by Dr. Lyell, in which the existence of man throughout the Glacial epoch is emphasised; and Mr. R. A. Smith's paper on prehistoric problems in geology, with the well-reported discussion on it (Proc. Geol. Assoc., vol. xxvi., 1915, p. 1) shows how far we have got from the old prejudices, which would have us believe that a deposit containing flint implements must necessarily be of post-Glacial age.

THE nature of "nardoo," the supposed nutritive food which led to such disastrous results during the ill-fated expedition of Burke and Wills, is discussed by Mr. E. H. Lees in the January issue of the *Victorian Naturalist*. It has been assumed that the true nardoo is made from the spores of a species of Marsilea growing in the swamps of Victoria. This, however, appears to be quite innutritious by itself, and nardoo made from leguminous seeds of various kinds is stated by the author to have been formerly supplied in establishments kept by natives. He maintains, in fact, that, in place of being the product of any one particular plant, nardoo is a compound made from several.

AN investigation into the limits within which the combined hysteresis and eddy current losses in iron per unit mass can be expressed by a single expression of the form, $W=cB^n$, has been carried out at Liverpool by Mr. N. W. McLachlan, who describes his results in a contribution to the Journal of the Institution of Electrical Engineers. Measurements were made by the Epstein alternating-current method with various brands of iron, and the curves obtained were analysed. It was finally found that such a formula would be accurate within from 1·5 to 2·5 per cent. for various materials tested, between the flux densities of 4000 or 5000 and 10,000 lines per sq. cm., and frequencies from 26 to 60 cycles per sec., the index n varying from 1·68 to 1·83, according to the material. Going closer into the matter, the constant c was found to vary directly with the frequency and the relation which exists between n and f was of the form $n=cf^{n_1}$.

THE results of a long series of researches on the conditions affecting the strength of wireless signals is published in a paper by Prof. E. W. Marchant, read before the Institution of Electrical Engineers recently. Daily observations, unhappily interrupted by the war, were made at Liverpool of the strength of signals sent out by the Eiffel Tower with a carefully calibrated apparatus and recorded by a suitable galvanometer. Attempts were made to draw general conclusions from the result, but in the opinion of several well-known wireless telegraph engineers who took part in the discussion, there was, in the absence of a control station near Paris, scarcely sufficient proof that the variations in received signal strength were due entirely to the degree of ionisation or other conditions in the intervening medium. Be this as it may, however, Prof. Marchant was able to show that the ratio between the day and night signal strength varies with the time of the year, and that the strengthening after sunset is less marked in rain than in clear weather, and is different in different directions. The greatest variations were observed at night. In his own opinion, moreover, the character and strength of the variations do point to the conclusion that the main factor which controls them is the state of ionisation of the atmosphere; he suggests that clouds of ionised air may exist in the upper regions of the atmosphere which act as mirrors for the waves and cause the sudden changes in signal strength that have been observed.

THE applications of electrical engineering to warfare formed the subject of an exceptionally interesting discussion at the Students' Section of the Institution of Electrical Engineers on March 3, under the chairmanship of Mr. W. Duddell. Mr. P. R. Coursey opened the discussion on "Communications," stating that the utilisation of the electrical telegraph for military purposes dated back only to the Boer war. In the Russo-Japanese war, field telegraphy and telephony, and also wireless telegraphy, were used; while in the present war not only do field telephones, and telegraphy with Morse sounders and "vibrator" instruments take an important part, but telegraphy is so much employed that transmission with Wheatstone automatic instruments actually finds useful application. Use is also made of wireless telegraphy. In the course of the discussion it was mentioned that, for wireless telegraph reception by airmen, pneumatic head-piece "shock-absorbers" are employed to deaden the noise of the engine. The subject of "The firing of mines and explosives" was opened by Mr. S. Killingback, who said that electric firing had the advantage over hand firing with time fuses, that it was more convenient and trustworthy, and also rendered possible remote control and the simultaneous firing of several charges. The standard electric fuses and detonators require about 0·8 ampere to actuate them, and are fixed either by accumulators or portable hand-operated service dynamos. One speaker in the discussion expressed the opinion that trinitrotoluene was superseding gun-cotton and gunpowder for the fuses, and another stated that electric firing had not been employed in the Russo-Japanese war, suggesting that its chief field in warfare was for the firing of mines for harbour protection for which more trustworthy and permanent cables could be laid. Mr. Duddell reminded the meeting of an exploder (of German make) captured from the Boers, which had been preserved in the Institution library.

THE harmful effects of aldehydes in soils are described by O. Schreiner and J. J. Skinner in Bulletin No. 108, Bureau of Soils, U.S. Department of Agriculture. In the course of examination of an acid garden soil for organic substances, salicylic aldehyde was isolated in amount sufficient to enable its effects

to be tested on wheat plants grown in water culture. The harmful effect of the aldehyde, when added both to distilled water and to nutrient culture solutions, was so striking that an extensive series of experiments was undertaken in order to study the action of this compound on various plants and in various culture solutions, in soil in pots, and finally in the field. The plants used for the water culture experiments included wheat, maize, cow-peas, cabbage, and rice; for pot experiments trials were made with wheat, maize, and clover. In every case the depressing effect of the aldehyde was clearly shown. Thus in the case of wheat the addition of ten parts per million of salicylic aldehyde in distilled water reduced the growth by 31 per cent. compared with the control; with fifty parts per million the plants were killed. The experiments suggest that calcium carbonate and calcium phosphate restrain the toxic action of the aldehyde to a slight extent, but the cultures under alkaline conditions indicate that its harmfulness cannot be attributed to any slight acidity it may possess. Field trials made with cow-peas, beans, and garden-peas showed that these crops were all reduced when grown in soil treated with the aldehyde. Finally, seventy-four samples of soils, taken from various parts of the United States, were examined for aldehyde compounds; seventeen of these gave positive results. Ten per cent. of the soils known to be productive and 33 per cent. of unproductive soils contained aldehyde. The infertility of many of the soils is obviously due to causes other than the presence of toxic compounds, and especially of a particular toxic compound.

AN interesting letter from Prof. John Perry appears in *Engineering* for March 12. The subject dealt with is cheap and rapid gun-making, and Prof. Perry describes some experiments carried out under his instructions at Elswick, in which a cylinder of ordinary nickel steel, such as is used in guns, was constructed in such a manner that successive charges were exploded in it, finally reaching the high figure of 52 tons per square inch, without apparent damage to the cylinder. The cylinder was cast solid, or nearly solid, under pressure, and turned and bored not quite to the finished sizes. The ends were closed, and means adopted for filling it with fluid under pressure. The temperature was maintained by rings of gas jets outside (this prevents the yielding material from hardening too much). The internal pressure was raised rapidly to 17 tons per sq. in., and afterwards, during many hours, the pressure was increased gradually to 40 tons. It had been intended to increase the pressure until the outside diameter became permanently (and not merely elastically) larger. Prof. Perry gives a full account of the theory in his letter, together with tables of values of the internal stresses, from which the thickness of gun tubes can be calculated.

A PAPER was read by Sir Thomas Mason at the Institution of Civil Engineers on March 9, giving particulars of the improvement of the River Clyde and the harbour of Glasgow from 1873 to 1914. In 1873 the river from Glasgow to Port Glasgow had an average depth of 15 to 18 ft. below low water, and 25 to 28 ft. at high water. The largest vessels navigating the river had a draught of 22 ft. The total quayage of the harbour was 6410 yards in length, and the water-area was 76 acres. During the period considered, the Queen's Dock, Prince's Dock, Rothesay Dock, and several graving docks have been completed. Improvements on the river have had the effect of reducing the time of flow between Greenock and Glasgow; low water has fallen at Glasgow about 2 ft., and is now 5 in. lower than at Greenock. In 1873 springs rose 10 ft. 6 in.; now the rise is 12 ft. 2 in. The tonnage of trading vessels has increased by 325 per cent., length by 56 per cent., breadth by 69 per cent., and draught by 48 per cent. Quayage has increased three times; tonnage of goods handled four and a half times; and revenue nearly three and a half times. The water-area of harbour and docks is now 535 acres.

OUR ASTRONOMICAL COLUMN.

MELLISH'S COMET (1915*a*).—A recent number of the *Comptes rendus* (vol. clx., No. 9, p. 301) publishes observations of Mellish's comet made at the Observatories of Lyons and Marseilles. The observations at the former were made by M. J. Guillaume between February 20 and 26. The comet is described as of the eleventh magnitude, with the aspect of a circular nebula about a half-minute of arc in diameter, with vague boundaries, and with a condensation or very small nucleus excentric towards the sun. The note by M. Coggia on the observations at Marseilles describe the appearance of the comet as diffuse, irregular, without any brilliant part or condensation. Its magnitude is given as 11. The ephemeris given in this column last week extends up to March 24.

SUN-SPOT AND MAGNETIC ACTIVITY IN 1913.—Prof. A. Wolfer brings together in the *Astronomische Mitteilungen* (No. 105, p. 115) the very valuable statistics of the solar and magnetic acitivity for the year 1913. The statement is based on the large number of observations made at numerous observatories, and affords a ready means of comparing the relative changes which occur from one year to another. The year 1913 seems to have been a very quiescent one according to the value arrived at for the spot activity, and the diminution in activity from the year 1911 will be seen from the following figures:—

1911, 5·7; 1912, 3·6; 1913, 1·4.

This quiet state of spot activity is in close accord with the condition as deduced from the discussion of the mean areas and heliographic latitudes of sun-spots in the year 1913 at the Royal Observatory, Greenwich (*Monthly Notices*, R.A.S., vol. lxxv., No. 1, p. 16).

The value for the daily variation of magnetic declination, on the other hand, has shown a pronounced indication of activity for the year 1913, showing that the minimum took place in 1912, a year earlier than that of the sun-spot.

REPORT OF MOUNT WILSON SOLAR OBSERVATORY.—The annual report of the Mount Wilson Solar Observatory gives the reader a good insight into the remarkable activity that has been, and is, in progress. Before proceeding to give somewhat in detail an account of the work in the various departments, the director, Prof. G. E. Hale, enumerates in the fifty-nine brief paragraphs the principal conclusions to which the work of the past year have led. These are, of course, too numerous to give here, but many of

the conclusions have been referred to in previous accounts of research work in this column. This report completes the first decade of operations on the mountain, and we are promised a brief outline of the work for this period. The past year is described as "one of the most productive of this period." We are told that solar research has progressed satisfactorily, that a beginning has been made in the application to solar phenomena of Stark's capital discovery of the effect of an electric field on radiation. One of the new conclusions in stellar astronomy promises to furnish the means of determining a star's distance simply by measuring its brightness and the relative intensities of certain lines in its spectrum. Laboratory investigations and the work of construction have gone forward rapidly. With regard to the last-mentioned, it is hoped to complete the dome for the 100-in. reflecting telescope next summer, and to set up the mounting in the autumn. The large mirror has already received an almost perfectly spherical figure, and preparations are being made for the work of parabolising it. The reader must refer to the report itself to note the progress made in the many and various investigations which are in operation, both on the mountain and at the base station.

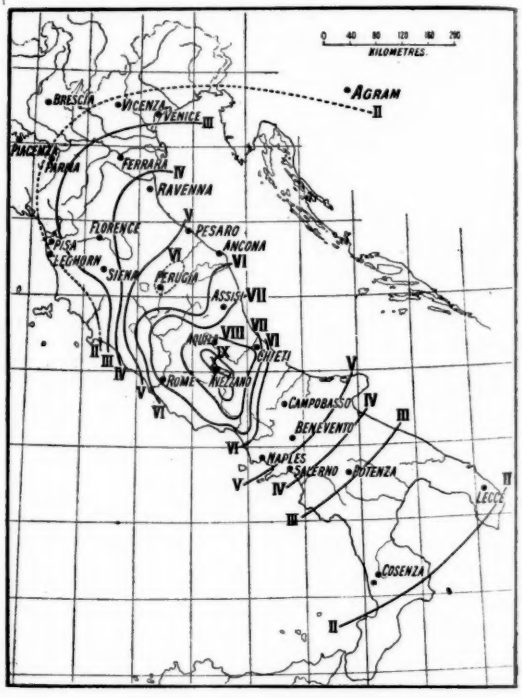
ANNUAIRE ASTRONOMIQUE ET MÉTÉOROLOGIQUE POUR 1915.—The fifty-first issue of the useful handbook entitled "Annuaire Astronomique et Météorologique" has just come to hand. M. Camille Flammarion, the originator and editor of this handy reference book, has, in spite of the recent difficulties met with in Paris, produced the volume up to the high standard of its predecessors. Most of the readers of this column know the arrangement and subjects of the contents so well that it seems necessary only to direct attention to the issue of the volume. Nevertheless it may be added that under the heading, "Scientific Notices," which is an annual review of the progress of astronomy, the reader will obtain a good broad view of the year's work, while in the numerous other sections dealing with the calendar, phenomena, astronomical tables, etc., illustrated by 120 figures of charts and diagrams, a mine of valuable material is included.

THE AVEZZANO EARTHQUAKE OF JANUARY 13.

FOR most of the details contained in the present paper I am indebted to the courtesy of Dr. G. Martinelli, of the Ufficio Centrale di Meteorologia e di Geodinamico at Rome, and of Dr. G. Agamennone, the well-known director of the Geodynamic Observatory of Rocca di Papa, near Rome.

The map of the isoseismal lines is a reproduction of that prepared by Dr. G. Martinelli from the numerous observations forwarded to the Central Office. The scale of intensity employed is that of the late Prof. Mercalli, which, in Italy, has superseded the Rossi-Forel scale. The degree X., for instance, represents the intensity of a shock capable of ruining many buildings and causing much loss of life; the degree VII. that of a shock that will throw down chimneys and produce slight cracks in numerous buildings; while the degree II. corresponds to a shock that can just be felt under favourable conditions by persons at rest. It will be seen that the isoseismal X. is an elongated curve including Avezzano at its western end. The isoseismal of intensity VII. is interrupted by the eastern coast of Italy, and extends beyond Rome to within a few miles of the western coast. The isoseismal of intensity II., which represents the boundary of the disturbed area, includes Parma, Mantua, Verona, and Venice to the north, and to the south approaches within thirty miles of Messina. Thus the area disturbed is not less than 550 miles in length. Its width is, of course, unknown, but, if the mean radius be taken as 275 miles, the total disturbed area must extend over about 240,000 square miles, an area about two-thirds of that shaken by the San Francisco earthquake of 1906.

Dr. Agamennone informs me that the first vibrations were registered at the Rocca di Papa Observatory at 6h. 52m. 54s. a.m. (G.M.T.), but the vibrations soon attained such strength that the seismographs there were thrown out of action. At Rome, a somewhat less sensitive seismograph registered the whole movement, though the pendular masses beat repeatedly against the screws which are arranged to protect the instrument from excessive oscillation. At Eskdalemuir, the first movement was recorded by the Galitzin seismograph at 6h. 56m. 45s., and the beginning of the principal portion at 7h. 1m., the instrument remaining in motion until 9h. 12m. Judging



from the seismogram obtained at this observatory, the epicentre was at the distance of 1930 km. in the direction 40° 50′ south of east; that is, in 42° N. lat., 14° E. long. The centre of the isoseismal line of intensity X. is in 42° 0′ N. lat., 13° 27′ E. long. According to a special seismological bulletin issued by the Georgetown (U.S.A.) University Department of Geology, the first tremors reached that place at 7h. 28m. 40s., and the first oscillations of the principal portion at 7h. 36m. 40s.

The Avezzano earthquake is noticeable for its extraordinary number of after-shocks. At Rocca di Papa, a sensitive microseismograph was at work again an hour after the principal shock, and, from January 13–29, this instrument registered more than 500 after-shocks. That the earthquake was tectonic in its nature is indicated by the extensive disturbed area, the registration of the movement at great distances, and the unusual frequency of the after-shocks.

The earthquake is being investigated by Dr. Mario Baratta on behalf of the Italian Geographical Society. A preliminary notice by Dr. G. Martinelli will appear in the next number of the *Bollettino* of the Italian Seismological Society, and will include the map of the isoseismal lines reproduced here, and also a map prepared by Dr. Baratta to illustrate the seismic history of the district. From the latter, it is evident that the epicentral area of the recent earthquake, though not far distant from the important seismic zone of Aquila, is one in which only earthquakes of slight intensity have originated in the past.

(Since the above was written, a short paper on the earthquake by Dr. G. Agamennone has appeared in the *Rendiconti* of the R. Accad. dei Lincei (vol. xxiv., 1915, pp. 239–46). The author states that the most sensitive microseismometrograph at Rocca di Papa (about forty-three miles from the epicentre) recorded 240 after-shocks from 8.37 a.m. to midnight (that is, from 7.37 a.m. to 11 p.m., G.M.T.) on January 13, and on each of the four succeeding days 120, 88, 38, and 30, the total number of after-shocks until February 6 being nearly 750, of which only about thirty were felt at the observatory or in the surrounding country.) CHARLES DAVISON.

SANITATION IN INDIA.[1]

WE have before us four volumes of papers presented to the All-India Sanitary Conference held at Lucknow in January of last year. Vol. ii. commences with an interesting account of the methods by which in Italy the silt of rivers is utilised for raising the level of the soil, while at the same time the level of the water is lowered by drainage. The system can be carried out with the primary object in view of reclaiming swampy land or the agricultural improvement can also be considered, an almost necessary procedure from the financial side. How far the method is applicable to India is a matter of great interest. One factor that has to be determined is the amount of silt in the particular river under consideration, and, secondly, if agricultural improvement is to be considered, whether the silt is of manurial value. The views of the agriculturist, the engineer, and the sanitarian all need consideration in a problem of this magnitude. How manifold and fundamental the problems are, a consideration of the papers dealing with malaria will show. It is indeed no little achievement that this immense malaria problem is now being studied in India in all its aspects, and that its solution has already progressed far from the facile position held not so long ago by many that the filling up of a few pools and ditches was the answer.

An anti-fly campaign was carried out in Delhi with considerable success, the methods employed being:—(1) Either the burning of rubbish or covering it with one foot of earth; (2) the trenches of trenching grounds were cut 1½ ft. deep and covered with a foot of earth well-rammed down; (3) the use of incineration at the latrines; (4) the cleaning and sprinkling with pesterine of stables, cowsheds, backyards, etc.; (5) litter was removed daily or burned, bedding was changed at least once a week; (6) garden manure was not allowed to be exposed for more than four days—after this it must be dug into the ground and covered with a foot of earth; (7) butchers' shops and vegetable shops were dealt with; and (8) in private latrines, pucca floors and drains were made compulsory. The result of this campaign was that flies were "enormously reduced" and apparently the infantile mortality statistics. It was not, however, until the breeding-grounds within the city—*i.e.* those comprised under headings (4) to (8)—were dealt with that progress was made.

In England the essential points in the bionomics of the fly have been known for some years, but flies still infest our large towns. Is it the inadequacy of the powers possessed by the sanitary authorities that allows this insane condition to continue, or is it the apathy that allows us also almost without a murmur to permit foul smoke to be discharged from our chimneys?

The section on conservancy contains two interesting notes on the "pitting" of night soil, a simple and effective method of solving under certain conditions this ever-recurring problem. The essence of the method consists in sealing the pits from access of flies, etc., with road sweepings.

In vol. iii., the problems of tuberculosis and the very difficult one of a pure milk supply, water supply, notification of disease, and various questions in connection with sewage disposal, are discussed in several papers. An important one is the disposal of sewage sludge; the Grossman process in use in Oldham, where the sludge is dried and freed of its fat by passing steam through, yielding a valuable manure, seems successfully to solve the problem under certain conditions.

Vol. iv. The regulations for the control of malaria in Portuguese India are somewhat rigorous, *e.g.* all vessels intended to hold water will be closed and their contents changed *at least every two days*. Once a week at most is sufficient, as mosquitoes cannot develop from eggs in two days. Again, not only are ventilation outlets of drains to be furnished with wire gauze, but oil is to be poured into the openings to make assurance doubly sure, we suppose. A method for destroying larvæ that we do not remember to have seen mentioned before is contained in the following regulation. "Herds of animals will be introduced periodically (into ponds) to stir up the water, thus making it unsuitable for anopheline larvæ"!

In another paper figures are given which suggest that one species of malaria parasite prevails at one season of the year, another at another. If this is really so, and apparently similar results have been observed elsewhere, it would be important to know the reason for this.

A very interesting paper is that dealing with certain features of malaria in the island of Salsette. One main fact comes out, viz., that malaria increases as one approaches the hills. The study of the conditions in an island have always appeared to us especially interesting, and it is to be hoped that it can be repeated year after year. It shows clearly the great importance of an extended malaria survey of a district before houses are built anywhere and everywhere without consulting expert sanitary opinion.

Another interesting point is the effect of sea breezes in reducing the endemic index of malaria; "villages exposed to the sea-breezes have no spleen rate at all." Emphasis is also laid on that ubiquitous evil, the "borrow" pits along the railway track. Under existing conditions the only practical policy recommended is the abolition of these pits, the exposure of villages to sea breezes by the cutting down of grass and undergrowth, the institution of travelling dispensaries, and the proper control of new building schemes. A general attack on breeding-grounds in rural districts seems impossible. Certain areas of the island are free from malaria, and development should be recommended in these. The question of rice fields and malaria is one of first-rate importance. It would appear that we can get in a rice cultivation area three conditions:—(1) Healthy: spleen rate, 4·3 per cent.; (2) malaria endemic: 24·1 per cent.; (3) malaria hyperendemic:

[1] Supplement to the Indian Journal of Medical Research. Proceedings of the Third All-India Sanitary Conference held at Lucknow, January 19–27, 1914. Vol. ii., Papers, pp. ii+186. Vol. iii., Papers, pp. iv+220. Vol. iv., Papers, pp. iv+212. Vol. v., Papers, pp. iv+226. (Calcutta: Thacker, Spink and Co., 1914.)

70·5 per cent. The healthy areas are in the open plains, the hyperendemic areas at the foot of the mountains, where shade produced by forest, jungle, long grass, scrub, etc., exists, and (3) the endemic area with intermediate conditions. These data illustrate also the great value of malaria surveys before recommendations based simply on general principles are carried out.

Guinea-worm prevails to the extent of as much as 4 per cent. in some of the Indian jails. In a certain Bombay village over a third of the Cyclops in the village well contained larvæ, but the villagers put all the usual obstacles in the way of improving the well and their health.

Vol. v. contains an extremely interesting method of classification of Anophelines based on the distribution of "spots" on the wings; three main groups, Protoanopheles, Deuteroanopheles, and Neoanopheles, are easily separated.

The problem of the mode of dissemination of kala-azar is still *sub judice*; the balance of opinion favours the bed-bug as the agent. It has occurred to the writer as a not impossible hypothesis that perhaps this and some other diseases are not insect-man-insect diseases, but insect-man diseases only, *i.e.* the infecting agent is inoculated into man from and by an insect, produces its ill-effects, but is not further transmissible.

As regards the destruction of rats in plague prophylaxis, we have the merits of two methods put forward, viz.: (1) phosphorus, made up in attractive balls containing less than 3 per cent., and (2) hydrocyanic acid gas. This last kills not only rats but fleas, and its only drawback appears to be its very poisonous character. Its detection, however, is an easy matter, viz., by means of a paste which forms with it prussian-blue. The amount requisite is $\frac{1}{2}$–$\frac{3}{4}$ of an ounce of potassium cyanide per 100 cu. ft. It has many advantages over the sulphur dioxide or carbon monoxide methods.

There are many other subjects, such as vital statistics, water filtration, that we have not alluded to, but one would refer those who wish to obtain a general idea of the scope of these important conferences to the summary contained in the *first* volume. We ought to end with a word of congratulation on the splendid work that is being done. J. W. W. S.

ORNITHOLOGICAL NOTES.

IN the February number of *British Birds* Miss M. D. Haviland continues her account of ornithological observations made in the delta of the Yenisei, dealing in this instance with the little stint. So fearless during the nesting season were these birds that it was with difficulty they were kept far enough away from the camera to admit of the taking of a satisfactory photograph; and a brooding cock captured by the author in her hands, when released returned to the young. In six out of eight instances the sitting birds were cocks, but whether both sexes take their share in incubation was not ascertained.

The distribution of birds in Ceylon, in relation to recent geological changes in that island, forms the subject of an article by Mr. W. E. Wait in *Spolia Zeylanica* for December, 1914. (vol. x., part 36). A large proportion of the resident birds, especially in the Kandyan provinces and the wet zone of the low country, are of a Malabar type; but in the north and north-west there is a nearer affinity with those of the Carnatic. Of the peculiar species, the greater number pertain to the Malabar type of the fauna, and have their headquarters in the wet zone, but there are also a few with a Himalayan or Malay *facies*, although none of the Carnatic types. As the theories advanced by the author to explain these peculiarities in distribution are confessedly tentative, quotation seems unnecessary.

In the *Zoologist* for February Miss W. Austen records the appearance of a flock of about thirty long-tailed tits in a garden at Maida Hill on October 1, 1914, an occurrence which the editor believes to be altogether unprecedented.

To the January number of the *Auk*, and likewise to *Blue-Bird* for the same month, Dr. R. W. Shufeldt contributes a note on the last survivor of the American passenger-pigeon, which died in the Cincinnati Zoological Gardens on September 1, 1914, at the age of twenty-nine years. Immediately after death the body, packed in ice, was forwarded to the National Museum at Washington, where the skin was carefully removed for preservation, doubtless in the study series. Before this took place a photograph of the head and neck was taken and coloured with Japanese tints from the specimen; this photograph, after the insertion of an artificial eye, being reproduced in colour in the aforesaid issue of *Blue-Bird*.

R. L.

NOTES ON GLASS.[1]

A CERTAIN amount of experimental work on glass-ware of various kinds has been carried out recently at the National Physical Laboratory, and it may be of interest to make known some of the results.

Chemical investigations have for some years been dependent on German glass; the publication of the analyses and of test results may, it is hoped, lead some English firms to produce articles which may replace those of German manufacture.

The first table gives the analyses of some thermometric and chemical glass-ware.

Analyses of Thermometer and Chemical Glass-ware.

	Thermometer Glasses		Schott and Gen., Jena		Chemical Glassware		
	Jena 59^{III}	Jena 16^{III}	Original	"New"	Resistance "R"	Kavalier's Bohemian	Thuringen
Silica	72·86	66·58	66·74	64·60	68·00	76·02	74·36
Alumina	6·24	3·84	2·77	6·24	2·32	0·64	0·90
Lime...	0·35	7·18	0·28	tr.	4·80	7·38	9·40
Zinc oxide ...	—	6·24	8·28	10·43	2·40	—	—
Manganese oxide	tr.	0·28	0·65	tr.	0·14	tr.	tr.
Ferric oxide ...	tr.	tr.	tr.	tr.	tr.	tr.	tr.
Lead oxide ...	—	—	—	—	—	—	—
Soda (Na_2O) ...	9·82	14·80	8·99	9·71	10·17	7·60	14·83
Potash (K_2O) ...	0·10	tr.	0·08	tr.	1·82	7·70	0·14
Boric anhydride.	10·43	0·91	7·18	8·70	5·53	—	—
Magnesia	0·20	0·17	4·50	0·32	5·04	0·30	0·16
Arsenious oxide.	—	—			0·24		
	100·00	100·00	99·47	100·00	100·46	99·64	99·79
	*	*		*			

Analyses made with an asterisk have been made at the N.P.L. The other analyses are taken from a paper by Walker in the Journal Am. Chem. Soc., xxvii., 865, 1905.

(Bohemian and Thuringen glass is now rarely used in chemical work, but the analyses given are of the best material of that class.)

Resistance of Various Chemical Glass-ware to the Action of Chemical Attack.

The table below, taken from the work of Mylius and Foerster on this subject, gives the action of

[1] From the National Physical Laboratory, February, 1915.

various chemical reagents on glass used for chemical purposes (for analyses, see foregoing table):—

Beakers.

Water.

Type of Glass.	20°	80°	H_2SO_4	NaOH	Na_2CO_3
"R" ...	0·0054	0·0144	0	41	23
Jena ...	0·0071	0·0035	0	53	19
Bohemian	0·118	0·219	5	37	49

Flasks.

Water.

Type of Glass.	20°	80°	H_2SO_4	NaOH	Na_2CO_3
"R" ...	0·0128	0·0128	0	51	26
Jena ...	0·0063	0·0057	0	63	24
Bohemian	0·093	0·255	11	52	70

The figures are in milligrams per sq. dcm.

The solutions, viz. 2N.NaOH and N.H_2SO_4, were allowed to act at 100° for six hours, and 2N.Na_2CO_3 for three hours.

The Jena glass used was probably of the composition given in the first foregoing table under description "Original." This glass is now not used, but has been replaced by the new Jena glass, an analysis of which has been made at the National Physical Laboratory. Soon after the introduction of this new Jena glass by Schott and Gen., viz., in 1910, some tests were made at the National Physical Laboratory. A special feature of the new glass was its increased resistance to attack; this was brought about by long exposure to sulphureous gases. The tests on the glass before and after such treatment are given in the table below. Several kinds of vessels were tested, and the results for all were substantially the same.

Tests made at the N.P.L. in 1910 *on "New" Jena Glass.*

Mark: (1) Vessels had received no annealing.
(2) Vessels had received ordinary annealing.
(3) Vessels had received special annealing in sulphureous gases for thirty-six hours.

Beakers.	Milligms. Na_2O per sq. dcm. given up to water at 20°C. in 1 week.	Milligms. Na_2O per sq. dcm. given up to water at 80°C. in 3 hours.
1 ...	0·0022	0·0045
2 ...	0·0032	0·0047
3 ...	0·0019	0·0040

In the following table the figures give the loss in weight in milligms. per sq. dcm. after the treatment stated.

Beakers.	3 hours with 2N NaOH at 100°C.	3 hours with 2N Na_2CO_3 at 100°C.	6 hours with N H_2SO_4 at 100°C.
1 ...	51	9	nil.
2 ...	51	8	nil.
3 ...	55	7	nil.
Conical Flasks			
1 ...	63	8	nil.
2 ...	60	11	nil.
3 ...	71	10	nil.
Flat-bottomed Flasks			
1 ...	62	8	nil.
2 ...	71	8	nil.
3 ...	79	6	nil.

There was a small improvement as regards resistance to the attack of water, but no improvement to the attack of alkalies. Since its introduction this type of glass-ware has been used in the National Physical Laboratory and has given every satisfaction.

It is well known that alkaline fluids attack glass very markedly, and for that reason in chemical analyses prolonged contact is avoided. To do this is not always possible, *e.g.* in the estimation of zinc and manganese, especially in silicate analyses. It is necessary in the estimation of these metals to employ solutions containing alkaline chlorides and ammonium sulphide, and to allow the solutions to stand at a rather high temperature (50–60° C.) for sometimes as long as twelve hours. In these circumstances the glass is invariably attacked, and although no quantitative experiments have been made with the Jena glass, the resistance to the attack of these solutions is certainly not as good as with the alkaline solutions in the absence of chlorides and sulphides. In view of the fact that glass flasks have to be used for this purpose, it seems desirable to devise a test, in addition to the tests usually carried out, to determine the ability to withstand the joint action of alkaline chlorides and sulphides.

The new Jena glass examined at the National Physical Laboratory in 1910 possessed in a very high degree the ability to withstand sudden change of temperature. A glass flask filled with molten paraffin wax at a temperature of 250° C. broke when placed suddenly in water at 15° C., but only after successfully standing such a test at slightly lower temperatures.

Another question which is engaging attention is glass for miners' lamps, incandescent chimneys, steam gauge tubes, and other purposes in which a gradient of temperature is established between the inside and outside.

Analyses of some of these glasses are given in the following table:—

Analyses of Lamp Glasses.

	Jena Incandescent Gas (Schott & Gen.) Best Quality.	Miner's Lamp Glass. German Make. Mark A [1] B.	Miners' French Lamp Glass (Yellow).	Miners' French Lamp Glass (Colourless).	Austrian Lamp Glass "Sun Brand."
Silica...	73·88	74·28	51·26	54·92	76·78
Alumina	2·24	3·24	6·90	1·28	0·72
Lime	tr.	tr.	tr.	tr.	6·52
Zinc oxide ...	tr.	tr.	7·16	0·82	—
Manganese oxide	tr.	tr.	tr.	tr.	tr.
Ferric oxide ...	tr.	tr.	tr.	tr.	tr.
Lead oxide ...	—	—	27·54	34·93	—
Soda (Na_2O) ...	6·67	6·73	tr.	2·08	11·14
Potash (K_2O) ...	tr.	tr.	2·67	4·54	4·74
Boric anhydride.	16·48	15·02	3·97	—	—
Magnesia	tr.	tr.	tr.	0·20	0·24
Arsenious oxide.	0·73	0·73	—	0·99	—
Antimony oxide.	—	—	0·50	—	—
	100·00	100·00	100·00	99·76	100·14

It appeared, however, from Hovestadt's book on glass, and other information, that the additional strength of the German glass was conferred on it in great measure by its heat treatment, and tests were made to investigate the state of strain in the glass.

For this purpose the following glasses were examined:—

(1) A miner's lamp chimney of white glass of German manufacture.

(2) A miner's lamp chimney of yellow glass of French manufacture.

(3) A piece of "Durax" tubing as used for chemical purposes.

From each of these tubes two rings of about 1 cm. depth were prepared by making transverse cuts across the tubes; the plane surfaces of the rings were optically polished. One ring of each specimen had a piece cut out so that the ring was free to spring. Other

pieces were prepared for the determination of the refractive properties of the glasses.

The three open and three complete rings were examined in plane polarised light for strain. The examination showed that in both rings of the French glass, and in the open ring from the German lamp chimney, the amount of strain was negligible. In the unbroken ring from the German chimney there was very decided strain. Strain was also present in both rings of the "Durax" glass, the unbroken ring of this material showing much more pronounced strain than any of the other rings. The appearance presented by the rings when examined in the dark field is a very strong and sharp black circular line in the middle of the glass with a decided black cross upon it, and the rest of the ring either white or milky.

The character of the strain present in the unbroken ring from the German chimney was determined by distorting the ring into an elliptical form by compression between two points at opposite ends of a diameter of the ring inclined at 45° to the plane of polarisation. By this means the milkiness could be made to disappear entirely from the regions about the diametrical plane perpendicular to the line of compression, but the strain in the neighbourhood of the points of compression was increased. This shows that the strain is relieved by an increase in the curvature, and augmented by a reduction in the curvature; in other words, the inner layers of the ring are in a state of tension, and the outer layers in a state of compression. The fact that in the open ring the strain throughout is practically entirely relieved suggests that these chimneys are made in one operation, and not by the combination of layers of material at different temperatures. It is evident that with the distribution of strain in the cold state indicated above, the chimney will tend to be relieved of strain when there is a radial temperature gradient throughout its substance with the outer surface cooler than the inner surface.

With the "Durax" tubing there is in neither ring freedom from strain. In the open ring the strain becomes worse on altering the curvature in either direction. Perhaps this indicates that the tube is built up of layers of the same or different materials, but brought together with one layer decidedly cooler than another. The presence of a thin white band in the substance of the glass may also indicate that the tube has been built up in the way suggested. An examination of all the rings in ordinary light showed the presence of striæ likely to prevent the formation of really sharp spectrum lines in the determination of their refractive properties. This expectation was fully borne out by the appearance of the lines in the refractometer. No indication was obtained that any tube consisted of more than one type of glass, but the want of sharpness in the lines was sufficient to obscure the difference between glasses of very nearly identical optical properties. The results obtained in these measurements are as follows:—

	n_D	$n_C - n_F$	ν
German chimney ...	1·4795	0·00729	65·8
French chimney ...	1·5748	0·01313	43·8
"Durax" combustion tubing	1·5156	—	—

The *optical* glasses which resemble the above in refractive properties are, for the German chimney one of the new "Fluor Crowns," for the French chimney a light flint, and for the "Durax" tubing a hard crown.

Experiments were made to determine possible variations in the strained condition of lamp chimneys due to internal heating and resulting temperature gradient across the glass.

Coils of wire were wound round a cylindrical metal core, the whole enclosed in asbestos paper and fitted closely (without mechanical strain) into the ring of the chimney examined. A thermo-couple was introduced between the lagging and the glass to enable the temperature of the latter to be determined on the passage of a current through the heating coil.

French Chimney.—This was initially when cool without strain. On heating up strain was found to develop progressively as the temperature rose, and there is no evidence that at any temperature the strain declines to a minimum again.

German Chimney.—When cool and at uniform temperature this showed very decided strain in the shape of a central ring and cross. On heating up the ring the strain was relieved, but the glass is never *entirely* freed from the strain as evidenced by a complete absence of the stauroscopic figure. The tendency is rather for the central dark ring to move outwards and to be replaced eventually by another ring moving out from the inner surface of the glass ring. There is nevertheless a decided minimum effect, *i.e.* minimum strain, obtained when the temperature of the inner surface of the glass ring is about 150° C. (±20°). The temperature gradient across the glass is such that in the steady state the temperature of the outer surface of the lamp, corresponding with the above internal temperature, is roughly 70°, within the same limits of accuracy. Excessive heating above these limits results merely in producing a more pronounced strain.

A further chemical analysis of the inner layers confirmed the view that the German miner's lamp chimney is of a single material.

The incandescent lamp chimneys are very thin and optical examination is not possible, but it appears fairly certain that in their case also the extra strength is attained by some process whereby the outside is chilled before the interior cools down. It seems possible also that the extra heat-resisting qualities of certain beakers, flasks, etc., of German glass may be due to the converse process, the interior being chilled previously to the exterior. All these glasses appear to be of the borosilicate type, such as is used for the well-known thermometer glass 59^{III}, but with somewhat more boric anhydride; the chemical glass contains zinc oxide, which is absent from the thermometer glass.

As already stated, the object of these notes is to put such information as is available before English manufacturers in the hopes of encouraging some of them to take up the manufacture of some of these glasses.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

DR. R. TRAVERS SMITH has been appointed to the chair of materia medica, therapeutics, and pharmacology in the school of surgery of the Royal College of Surgeons in Ireland.

THE will of the late Mr. W. E. Allen, chairman of Messrs. Edgar Allen and Co., Ltd., of the Imperial Steel Works, Sheffield, who died in Jnuary last, provides that two-fifths of the residue of his property after the payment of numerous bequests to charities and employees, shall be given to the University of Sheffield, to be applied as to 5000*l.* to the Applied Science Department, and as to the balance, in the discretion of the University Council, in founding Edgar Allen scholarships or exhibitions for students of that University, of whom one-half shall be sons of workmen earning daily or weekly wages or foremen of workmen or managers. The gross value of the

estate was 271,068*l.*, and about 150,000*l.* is devoted to bequests for charities and employees.

THE annual gathering of the South-Western Polytechnic was held on Friday, March 12. The chair was taken by Archdeacon Bevan, and Mrs. Hayes Fisher distributed the certificates and prizes. The report of the principal showed that the chief feature of the session 1913–14 was the large number of scholarships gained by the past and present evening students. These scholarships included a Beit fellowship, the research studentship at Emmanuel College, Cambridge, a science scholarship and an art scholarship given by the London County Council. Amongst the degrees gained in London University were three D.Sc. degrees in chemistry. The principal also directed attention to the large number of present and past members of the institute who were serving with the forces. A vote of thanks was proposed by the Mayor of Chelsea, Principal Hudson, of St. Mark's College, and was seconded by Mr. J. B. Coleman, who gave some account of the present condition of chemical industries and of what the chemical department of the institute was doing to help those industries.

THE steady progress of education, and especially of scientific education, in India, has frequently been noticed in these columns, and we are glad to see confirmatory evidence in the *Presidency College Magazine*, issued from the Presidency College, Calcutta, and edited by Mr. Joges Chandra Chakravarti. The magazine contains some interesting papers and notes, and prominent among them is an article on Prof. H. E. Armstrong's visit to Calcutta as reader in chemistry to the University, when he delivered a course of five lectures. There is also a review of "Forty Years of Progress of Chemistry at the Presidency College," by Dr. P. C. Ray, showing how a school of chemical research is being gradually built up, of which Dr. Ray himself is the leader. A very appreciative obituary notice of Prof. J. A. Cunningham, who was professor of chemistry at the Presidency College from 1906–9 is given. Further, a series of notices of eminent Presidency College men is published, and the subject of the article in this number is Sir Asutosh Mookerjee, lately Vice-Chancellor of the University, who has done much for Indian education.

THE number of undergraduates in residence at Oxford and Cambridge, as stated in a note on March 4 (p. 24) is almost exactly one-third that of a year ago, the other two-thirds—about 2000 from each University—being on active service with the Army or Navy. According to the *Kreuz-Zeitung* there are upon the books of the twenty-two German universities—the twenty-second university being that of Frankfurt a/M., opened in October last—for the winter semester, including those at the front, 52,504 students, of whom 4000 are women, as against 59,600 and 3700 respectively last year. On leave—*i.e.* on military service—there are 29,882 students, including 300 women, mostly students of medicine. There are present in the universities 18,922 men and about 3700 women. Of those present, 1500, including several hundred women, are foreigners. The number of students on military service is, however, larger than appears from these statistics, since the Technical High Schools have not been taken into account. The real number is only obtained by subtracting from last year's number of German men students those of this semester, which gives about 32,000 students in the field. This does not even include those called to arms after the closing of the statistics Their number is at least one-third of those present, so that the number of students under arms must be raised by a further 6300. Seventy-five per cent. of the German students are therefore in the field. Of the German students of Technical High Schools about 80 per cent. are in the army.

THE War Office gives notice that an Army entrance examination will be held on June 29 next. At this examination there will be open to competition:—(*a*) Not fewer than 125 cadetships at the Royal Military Academy, Woolwich (for the Royal Artillery and Royal Engineers); (*b*) not fewer than 300 cadetships at the Royal Military College, Sandhurst (for the Cavalry, Foot Guards, Infantry, and Army Service Corps). The competition will be conducted in accordance with the regulations issued in November, 1911, except that no oral or practical tests will be included in the examination. To be eligible to compete for admission to the academy, a candidate's age must be such that he will have attained the age of 16½, and will not have attained the age of 25, on July 1, 1915. To be eligible to compete for admission to the college, a candidate's age must be such that he will have attained the age of 17, and will not have attained the age of 25, on that date. The contributions usually paid by parents of cadets will be dispensed with in the case of candidates admitted as a result of this examination. This will not affect the payment of 35*l.* required for the provision of uniform, books, etc. A sum not exceeding 3*s.* a day will be contributed from Army funds towards the cost of each cadet's messing, washing, and contingencies. Camp kits are issued in kind at the academy or college. Outfit allowance of 50*l.*, from which the cost of the camp kit will be deducted, is issuable to cadets on appointment to commissions. A limited number of cadetships in the Royal Navy and supplementary first appointments in the Royal Marines will also be open to competition.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 4.—Sir William Crookes, president, in the chair.—Prof. W. A. **Bone**, Prof. H. L. **Callendar**, and H. J. **Yates**: A bolometric method of determining the efficiency of radiating bodies. In view of the increasing uses of incandescent surfaces in heating operations of all kinds, the authors have investigated, as a scientific problem, the measurement of radiant efficiencies of such surfaces, by a bolometric method, which can be standardised by direct comparison with a radio-balance, and which the authors propose to substitute for the existing *water-radiometer-cum-thermopile* method (known as the "Leeds method") used hitherto. The paper describes the construction and use of a new bolometer, specially designed for the purposes in view, in which the radiation from an incandescent surface, falling on a blackened coil of platinum wire, can be determined in absolute units for the increase in the electrical resistance of the receiving coil, the area of which is sufficiently small to allow of the instrument being standardised from a source of known intensity. And, by way of example, the application of the method to the measurement of both the absolute radiation of a gas fire and its "distribution factor," is described and discussed.—E. **Chappell**: The simplification of the arithmetical processes of involution and evolution. An arithmetical process can be said to be completely simplified when it is reduced to either addition or subtraction. The invention of logarithms completely simplified multiplication and division, but involution and evolution were only replaced by multiplication and division, so that these processes may still be laborious even with the use of logarithms. The paper describes

a table of the logarithms of numbers recently compiled, by the use of which involution and evolution are also completely simplified. The frequency with which fractional indices, positive and negative, occur in most branches of modern experimental science gives rise to the hope that the tables in question will accomplish for the modern investigator what logarithms did for the man of science of the seventeenth century.—F. E. **Rowett**: The elastic properties of steel at moderately high temperatures. The difference in the behaviour of hard-drawn steel tubes, before and after annealing, under stress, led to the experiments described in the paper. At a suitable temperature a hard-drawn tube, which contains a good deal of amorphous material, behaves like a viscous fluid, that is, it flows more or less freely under stress, whereas, at the same temperature, an annealed tube being crystalline will flow in a much less degree, corresponding to the small amount of amorphous material in it. At a temperature of about 300° C. a hard-drawn tube shows properties similar to those of pitch at ordinary temperatures or of glass at a temperature rather below its softening point. It is still highly elastic under rapidly varying stress, but flows perceptibly when the stress is applied for a long time. On the other hand, in the annealed tube at 300° C. the energy dissipated in a cycle of stress is still almost independent of the time taken over cycle. At a higher temperature, for example, at 540° C., the hard-drawn tube flows rapidly and continues to flow for a long period, though at a diminishing rate, under a shear stress of less than one ton per square inch. Moreover, like pitch or glass, the steel at this temperature shows considerable elastic afterworking. If the stress be suddenly removed the immediate elastic recovery is followed by a slow backward flow which persists for many minutes.—Prof. J. W. **Nicholson**: The laws of series spectra. The paper contains a critical analysis of the diffuse, sharp, and principal series of helium, especially in the light of recent interferometer measurements of the leading lines of these series. The investigation depends on a mode of accurate calculation of the limits of series, not dependent on the type of formula used. The limits of series with many lines, for which a Hicks formula is already known, can be calculated with extreme accuracy by a new method. Interferometer measures of leading lines of helium series enable the best form of the series to be obtained. This form is an extension of that of Rydberg, dependent on $m+\mu$ and not m. The value of Rydberg's constant, 109679·2, given by Curtis for hydrogen, is the true value for the arc spectrum of helium, and is, in fact, a rigorous constant for arc spectra. Spark spectra are not treated. The Rydberg-Schuster law of limits is exact for helium. It seems probable that μ is a simple fraction the denominator of which is a multiple of 5, as Halm has suggested. It is exactly 0·7 for the short series of helium.

March 11.—Sir William Crookes, president, in the chair.—E. **Heron-Allen**: Contributions to the study of the bionomics and reproductive processes of the foraminifera. The mechanical functions of the protoplasm in locomotion and food catching and its reaction to stimuli are considered. The phenomenon hitherto known as plastogamy is only fortuitously connected with reproduction, and is in most cases a budding-off of a daughter-individual from a parent shell. Certain species of foraminifera, if not all, vary the processes of reproduction by amœbulæ formed of protoplasm discharged from the shells, and by flagellispores, by the formation of fully formed and calcareously invested polythalamous young inside the parent shell which are set free by the resorption of the parent shell. The dual nature of the terminal chamber in *Cymbalopora brelloides*, d'Orbigny, is confirmed, and its functions in the life-history of the organism are discussed. A new species, *C. milletti*, Heron-Allen and Earland, is established. The species, *C. tabellaeformis*, Brady, is recorded as exhibiting a new phenomenon in the bionomics of foraminifera, namely, the excavation of crypts in suitable hosts where it passes its life, boring by chemical action tunnels for the protrusion of its pseudopodia. The secretion of calcium carbonate by porcellanous and hyaline foraminifera is considered, and the phenomena of "purpose" and "intelligence" are claimed as being exhibited by certain species of arenaceous foraminifera in the construction of their tests, either with a view to adaptation to environment or for defensive purposes. The "monadiform bodies" of Cymbalopora and the siliceous foraminifera from great depths, attributed to the late Sir John Murray, are explained by publication of his original notes made on board H.M.S. *Challenger*.—G. E. **Nicholls**: The occurrence of an intracranial ganglion upon the oculomotor nerve in *Scyllium canicula*, with a suggestion as to its bearing upon the question of the segmental value of certain of the cranial nerves. The occurrence of actively functional ganglion cells in large number, associated with numerous smaller and more deeply staining cells to form a small ganglion upon the oculomotor nerve in the adult *S. canicula*, has not hitherto been recorded. The true sensori-motor character of this nerve has recently been established by Sherrington and Tozer. This fact, in conjunction with the existence of the ganglion, becomes extremely significant, when it is remembered that the oculomotor plays an important part in the development of a related sympathetic ganglion (the ciliary). The author's suggestion is that the oculomotor be regarded as a distinct segmental nerve, not merely as a ventral root. From this it follows that the ophthal. profund. is not the dorsal root of the oculomotor neuromere, but has encroached upon that segment, while itself related to another (probably more posterior) head segment.—Prof. R. **Kennedy**: Experiments on the restoration of paralysed muscles by means of nerve anastomosis. Part III.—Anastomosis of the brachial plexus, with a consideration of the distribution of its roots. The experiments recorded consist of division of one or more roots of the brachial plexus and anastomosis of the divided root or roots either to another part of the plexus or to the spinal accessory. Restoration of function took place, and physiological examinations showed that this was due to the nerve which was substituted for the severed roots. When fewer than two roots were divided restoration of function took place much earlier, and was shown to be a spontaneous recovery due to the affected muscles being each supplied through more than one root.—A. F. S. **Kent**: The mechanism of the cardiac valves—a preliminary communication. The communication deals with the structure and mode of action of the auriculo-ventricular valves of the mammalian heart. Muscular tissue derived from the auricular wall runs for a considerable distance into the substance of the valve flaps, being situated principally towards their auricular surfaces. It is permissible to conclude that this muscle exercises an important function in connection with the closure of the valves. Receiving its stimulus from the base of the auricle, of which it is indeed an extension and with which it is directly connected, it comes into action at the appropriate moment in the cardiac circle, and contracts—and remains contracted—last of all the auricular muscle. Thus it keeps the valve flaps away from the ventricular wall, and ensures free play to the retro-valvular eddy right up to the time

when the valve closure begins to be finally accomplished. The function of the muscular slips now described may be regarded as a double one—(*a*) to keep the flaps away from the ventricular walls, and thus to ensure the provision of an adequate space between the flap and the ventricular wall for the full development of the retro-valvular eddy, and (*b*) to afford by their contraction direct mechanical assistance in the raising of the flaps into the position of final closure.

Geological Society, February 24.—Dr. A. Smith Woodward, president, in the chair.—Dr. J. E. **Marr**: The Ashgillian succession in the tract to the west of Coniston Lake. The author has studied in detail the succession of the Ashgillian strata in Ashgill Beck and the adjoining tract. An account of the lithological characters and lists of the fossil contents of the various divisions are given, and confirmatory sections from Coniston Village to Appletreeworth Beck are described. A comparison is made with the beds of the Cautley district, previously described by the author. Some fossils which have not yet been found in the Lower Ashgillian of the Cautley district occur in the beds of that division at Coniston. From a study of the fossils of the Coniston tract and of other areas in Britain and the Continent, it would appear that a twofold division of the Ashgillian strata which is of more than local value may be made. The lower division is characterised by the abundance of *Phillipsinella parabola*, and the upper by the profusion of *Phacops mucronatus*.—H. S. **Shelton**: The radio-active methods of determining geological time. The author holds that the radio-active method of determining geological time, while of great interest, is not of such certainty as to be independent of confirmation from other lines of investigation. The various radio-active methods, helium ratios, lead ratios, and pleochroic haloes are severally examined, and the various sources of uncertainty, general and particular, are pointed out. The most important general cause of uncertainty is to be found in the fact that mechanical and chemical changes of composition in minerals are the rule rather than the exception; and, in instances where constancy of composition throughout long periods of geological time is asserted, the burden of proof lies with those who make the assumption. The attempt to assess exact, or even approximate times by means of lead ratios is premature and entirely invalid. At the same time, the weight of the evidence is such as to render it exceedingly probable, so far as radio-active evidence goes, that geological time must be reckoned at least in hundreds of millions of years. There is a high degree of improbability that the errors in the radio-active methods should always be errors of over-estimation. The next step in the investigation of the time problem is to be found in a reversion to other lines of reasoning. The sea-salt methods, and those based on the thickness of the sedimentary rocks in particular, need careful reconsideration. Reference is made to a number of papers which show that the first of these is worthless, and the second based on a misapprehension of the nature of deposition. The argument from tidal retardation is still of value, as also is that from the evolution of carbonate of lime. To the author radio-active experiments come as a confirmation of views held on other grounds, but are not sufficiently important in themselves to be authoritative against the balance of the evidence derived from other lines of investigation.

Mathematical Society, March 11.—Sir Joseph Larmor, president, in the chair.—Prof. E. W. **Hobson**: Some theorems in the theory of series of orthogonal functions.—Major P. A. **MacMahon**: Investigations in the theory of the partition of numbers by a new method of partial fractions.—Col. R. L. **Hippisley**: Reciprocal and parallelogram linkages.—Dr. J. R. **Wilton**: A pseudo-sphere the equation of which is expressible in terms of elliptic functions.—T. C. **Lewis**: Circles and spheres, etc., associated with a triangle, orthocentric tetrahedron, etc.

PARIS.

Academy of Sciences, March 8.—M. Ed. Perrier in the chair.—The President announced the death of Prof. Hittorf, foreign associate.—A. **Leduc**: Diffraction phenomena and the motion of the earth. Pointing out an error in the calculations of Mascart in his memoir on the modifications undergone by light by reason of the movement of the source or the observer.—Emile **Saillard**: Catalysis in the oxidation of the alkaline sulphites. The oxidation of alkaline sulphites is retarded by the presence of saccharose, invert sugar, and other bodies, and accelerated by rise of temperature. The practical bearing of these observations on the process of sugar refining is discussed.—Maurice **Lugeon** and Gerhard **Henny**: The Canavese zone and the southern limit of the Alps.—Med. **Gard**: A hybrid of *Fucus ceranoides* and *F. vesiculosus*.—M. **Weinberg**: Researches on gas gangrene. In the majority of cases the organism producing the disease is *B. perfringens*. A description of the preparation of a vaccine and an antiserum (through the horse) is given; the latter appears to offer the most promising results.—Agasse **Lafont**, M. **Desmoulins**, and F. **Heim**: Pneumokoniosis in metal polishers.

BOOKS RECEIVED.

A Handbook to the Collection of Kaolin China-Clay and China-Stone in the Museum of Practical Geology, Jermyn Street, London, S.W. By J. A. Howe. Pp. viii+271. (London: H.M.S.O.; E. Stanford, Ltd.) 3*s*. 6*d*.

A Pocket Synopsis of the Families of British Flowering Plants (Based upon the System of Engler). By W. B. Grove. (Manchester University Press; London: Longmans and Co.) 1*s*. net.

A Birdlover's Year. By the Hon. Gladys Graham Murray. Pp. viii+150. (London: Eveleigh Nash.) 3*s*. 6*d*. net.

My Life. By Sir Hiram S. Maxim. Pp. ix+322. (London: Methuen and Co., Ltd.) 16*s*. net.

Annuaire Astronomique et Météorologique pour 1915. Pp. 436. (Paris: E. Flammarion.)

Carnegie Institution of Washington. Year Book No. 3, 1914. Pp. xvi+399. (Washington: Carnegie Institution.)

The Idols. By R. Rolland. Pp. 12. (Cambridge: Bowes and Bowes.) 6*d*. net.

A Manual of Oils, Resins, and Paints. By Dr. H. Ingle. Vol. i. Analysis and Valuation. Pp. 129. (London: C. Griffin and Co., Ltd.) 3*s*. 6*d*. net.

Geometry of Building Construction. Second Year Course. By F. E. Drury. Pp. xii+226. (London: G. Routledge and Sons, Ltd.) 3*s*. net.

Canada. Department of Mines. Mines Branch. Gypsum in Canada: its Occurrence, Exploitation, and Technology. By L. H. Cole. Pp. x+256. (Ottawa: Government Printing Bureau.)

Canada. Department of Mines. Geological Survey. Memoir No. 38. Geology of the North American Cordillera at the Forty-ninth Parallel. By R. A. Daly. Part i. Pp. xxvii+546. Part ii. Pp. xxvii+547–857. Part iii. Sheets 17. (Ottawa: Government Printing Bureau.)

The Counties of Moray and Nairn. By C. Matheson. Pp. x+139. (Cambridge: At the University Press.) 1*s*. 6*d*. net.

The Counties of Clackmannan and Kinross. By J. P. Day. Pp. viii+145. (Cambridge: At the University Press.) 1s. 6d. net.

The Teaching of Geography. By B. C. Wallis. Pp. viii+221. (Cambridge: At the University Press.) 3s. 6d. net.

Molecular Association. By Dr. W. E. S. Turner. Pp. viii+170. (London: Longmans and Co.) 5s. net.

Ancient Hunters and their Modern Representatives. By Prof. W. J. Sollas. Second edition. Pp. xxiii+591. (London: Macmillan and Co., Ltd.) 15s. net.

Sun Lore of All Ages. By W. T. Olcott. Pp. xiii+346. (New York and London: G. P. Putnam's Sons.) 10s. 6d. net.

English Folk-Song and Dance. By F. Kidson and M. Neal. Pp. vii+178. (Cambridge: At the University Press.) 3s. net.

German Culture: The Contribution of the Germans to Knowledge, Literature, Art, and Life. Edited by Prof. W. P. Paterson. Pp. x+384. (London and Edinburgh: T. C. and E. C. Jack.) 2s. 6d. net.

DIARY OF SOCIETIES.

THURSDAY, MARCH 18.

ROYAL SOCIETY, at 4.30.—Bakerian Lecture: X-rays and Crystals: Prof. W. H. Bragg.

ROYAL INSTITUTION, at 3.—The Form and Structure of the London Basin: Dr. A. Strahan.

ROYAL SOCIETY OF ARTS, at 4.30.—The Indian Army: Lieut.-Colonel A. C. Yate.

INSTITUTION OF MINING AND METALLURGY, at 8.—Annual General Meeting—Presidential Address: Sir Thomas Kirke Rose.

LINNEAN SOCIETY, at 5.—Hollow-shafted Feathers: W. M. Webb.—The Lichens of South Lancashire: J. A. Wheldon and W. G. Travis.—Coloured Drawings and Lantern Slides of 36 British Orchids: E. J. Beaford.—A Few Australian Plants: Dr. A. B. Rendle.

INSTITUTION OF PETROLEUM TECHNOLOGISTS, at 8.—The Internal Combustion Engine on the Oilfield: F. G. Rappoport.

INSTITUTE OF METALS, at 3.—A selection of the following papers:—Some Experiments upon Copper-Aluminium Alloys: J. H. Andrew.—The Constitution of the Alloys of Copper with Tin. Parts I. and II.: J. L. Haughton.—Etching Re-Agents and Their Applications: O. F. Hudson.—The Effects of Heat and of Work on the Mechanical Properties of Metals: Prof. A. K. Huntington.—The Quantitative Effect of Rapid Cooling upon the Constitution of Binary Alloys. Part III. (Conclusion): Dr. G. H. Gulliver.—The Properties of Some Nickel-Aluminium and Copper-Nickel-Aluminium Alloys: Prof. A. A. Read and R. H. Greaves.—Some Appliances for Metallographic Research: Dr. W. Rosenhain.—The Micro-Chemistry of Corrosion. Part III. The Alloys of Copper and Zinc: S. White.

FRIDAY, MARCH 19.

ROYAL INSTITUTION, at 9.—The Modern Piano Player—Scientific Aspects: Prof. G. H. Bryan.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—The Chemical and Mechanical Relations of Iron, Cobalt, and Carbon: Prof. J. O. Arnold and Prof. A. A. Read.

INSTITUTE OF METALS, at 10.30 a.m. and 3 p.m.—A Selection of the Papers enumerated above.

SATURDAY, MARCH 20.

ROYAL INSTITUTION, at 3.—Recent Researches on Atoms and Ions: Sir J. J. Thomson.

MONDAY, MARCH 22.

ROYAL SOCIETY OF ARTS, at 8.—House Building: M. H. Baillie Scott.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Spitsbergen in 1914: Dr. W. S. Bruce.

TUESDAY, MARCH 23.

ROYAL INSTITUTION, at 3.—The Belief in Immortality among the Polynesians: Sir J. G. Frazer.

ZOOLOGICAL SOCIETY, at 5.30.—Exhibition of Partridges and other Game Birds: W. R. Ogilvie-Grant.—Contributions to the Anatomy and Systematic Arrangement of the Cestoidea.—XVI. On Certain Points in the Anatomy of the Genus *Amabilia* and of *Dasyurotaenia*: Dr. F. E. Beddard.—The True Coracoid: R. Lydekker.—The Artificial Formation from Paraffin Wax of Structures resembling Molluscan Shells: J. T. Cunningham.—On Two new Species of *Polyplax* (Anoplura) from Egypt: Bruce F. Cummings.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Discussion:* The Improvement of the River Clyde and Harbour of Glasgow, 1873–1914: Sir Thomas Mason.—*Probable Paper:* On Impact Coefficients for Railway Girders: C. W. Anderson.

WEDNESDAY, MARCH 24.

ROYAL SOCIETY OF ARTS, at 5.30.—The Work of the War Refugees' Committee: Lady Lugard.

INSTITUTION OF NAVAL ARCHITECTS, at 11 a.m.—The Watertight Subdivision of Ships: Prof. J. J. Welch.—The Increase of Safety Afforded by a Watertight Deck: K. G. Finlay.—At 3 p.m.—The Influence of Discharging Appliances on the Design of Large Ore-Carriers: J. Reid.—The Scantlings of Light Superstructures: J. Montgomerie.—On the Strength and Spacing of Transverse Frames: C. F. Holt.

GEOLOGICAL SOCIETY, at 8.—The Stratigraphy and Petrology of the Lower Eocene Beds of the North-Eastern Part of the London Basin: P. G. H. Boswell.

THURSDAY, MARCH 25.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* On Forms of Growth resembling Living Organisms and their Products slowly deposited from Metastable Solutions of Inorganic Colloids: Prof. B. Moore and W. G. Evans.—The Production of Growths or Deposits in Meta-stable Inorganic Hydrosols: Prof. Moore.—A Contribution to our Knowledge of the Chemistry of Coat-Colour in Animals and of Dominant and recessive Whiteness: H. Onslow.

ROYAL INSTITUTION, at 3.—The Ground beneath London: Dr. A. Strahan.

CHILD STUDY SOCIETY, at 6.—The Care of the Teeth: C. E. Wallis.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Telephone Troubles in the Tropics: W. L. Preece.

INSTITUTION OF NAVAL ARCHITECTS, at 11 a.m.—A Contribution to the Theory of Propulsion and the Screw Propeller: F. W. Lanchester.—A Comparision between the Results of Propeller Experiments in Air and Water: A. W. Johns.—Further Model Experiments on the Resistance of Mercantile Ship Forms: The Influence of Length and Prismatic Coefficients on the Resistance of Ships: J. L. Kent.—At 3 p.m.—The Law of Fatigue Applied to Crankshaft Failures: C. E. Stromeyer.—The Effect of Beam on the Speed of Hydro-Aeroplanes: L. Hope.—Notes on the Cross Curves and GZ Curves of Stability: E. F. Spanner.

FRIDAY, MARCH 26.

ROYAL INSTITUTION, at 9.—Experiments in Slow Kathode Rays: Sir J. J. Thomson.

GEOLOGISTS' ASSOCIATION, at 8.—On the Structure of the Eastern Part of the Lake District: J. F. N. Green.

SATURDAY, MARCH 27.

ROYAL INSTITUTION, at 3.—Recent Researches on Atoms and Ions: Sir J. J. Thomson.

CONTENTS.

	PAGE
Science and Industry	57
The Chemistry of Food Products. By **E. F. A.**	59
Applied Botany	60
Lantern- and Micro-Projection	61
Mathematical Works	62
Our Bookshelf	63
Letters to the Editor:—	
Supposed Horn-Sheaths of an Okapi.—**Sir E. Ray Lankester, K.C.B., F.R.S.**	64
The Spectra of Hydrogen and Helium.—**T. R. Merton**	65
Musical Sand in China.—**Joseph Offord**	65
The Green Flash.—**Prof. W. Geoffrey Duffield**	66
Measurements of Medieval English Femora.—**Prof. Karl Pearson, F.R.S.**	66
The Principle of Similitude. By **Lord Rayleigh, O.M., F.R.S.**	66
Periscopes. (*With Diagrams.*) By **S. D. Chalmers**	68
Oil of Vitriol as an Agent of "Culture." By **T.**	69
Prof. H. W. Lloyd Tanner, F.R.S. By **R. H. P.**	70
Notes	71
Our Astronomical Column:—	
Mellish's Comet (1915*a*)	75
Sun-spot and Magnetic Activity in 1913	75
Report of Mount Wilson Solar Observatory	75
Annuaire Astronomique et Météorologique pour 1915	76
The Avezzano Earthquake of January 13. (*With Map.*) By **Dr. Charles Davison**	76
Sanitation in India. By **J. W. W. S.**	77
Ornithological Notes. By **R. L.**	78
Notes on Glass	78
University and Educational Intelligence	80
Societies and Academies	81
Books Received	83
Diary of Societies	84

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PAGE

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. 59
. 60
. 61
. 62
. 63

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. 64
R.
. 65
. 65
. 66
of.
. 66
gh,
. 66
. 68
. 69
. 70
. 71

. 75
. 75
. 75
015 76
ith
. 76
. 77
. 78
. 78
. 80
. 81
. 83
. 84

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